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Diffusion of Telemedicine:

A Multiple Case Study of Factors Influencing the Adoption of Telemedicine Technology

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Abstract of master's thesis

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Abstract

The use of telemedicine has been an emerging phenomenon in healthcare during past decades. In short, the term telemedicine refers to the process of exchanging of clinical information between two or more spatially separated parties. Telemedicine technology can be used to deliver medical knowledge and know-how to areas where this expertise is not otherwise available. In addition, telemedicine technology might prove to be beneficial for healthcare organizations in their pursuit to seek cost-savings and increased quality of service provided for the patients.

Although the information technology enabling the use of telemedicine systems has been developing at a fast pace, the diffusion of telemedicine technology in healthcare organizations has been modest. Several studies have been conducted on the acceptance of telemedicine technology but most of the emerged results could not be generalized in wider use due to the narrow scopes of the studies. Telemedicine systems implementation still lacks the best practices and solid evidence to back up the criteria to be considered when developing, deploying and using telemedicine technologies.

This thesis aims to increase knowledge about the factors affecting telemedicine adoption in individual and organizational level. To study the factors influencing the rate of diffusion of telemedicine technology in Finnish healthcare organizations, six case studies of telemedicine development, deployment and use are studied through analysis of semi-structured interviews. The empirical data gathered from the interviews is reflected with the prior academic literature on telemedicine diffusion explained through technology adoption models.

The key findings of the study suggest that the demonstrability of telemedicine technology's potential benefits, organizational structures that include telemedicine practices in daily routine and sufficient allocation of time to telemedicine use have the most substantial impact on telemedicine adoption. On the other hand, the protective organizational cultures and unclear benefits of the technology are likely to hinder the rate of the adoption in healthcare organizations.

Keywords Telemedicine, Healthcare, Technology Adoption, Information Systems

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Etälääketieteen käyttö on ollut alati voimistuva ilmiö 2000-luvun terveydenhuollossa. Lyhyesti etälääketieteellä tarkoitetaan sellaisia terveydenhuollon käytäntöjä, joissa kliinistä informaatiota vaihdetaan kahden tai useamman terveydenhuollon yksikön välillä tietoliikenneteknologiaa hyödyntäen. Etälääketiedeteknologiaa voidaan käyttää lääketieteellisen tietämyksen ja osaamisen viemiseen alueille, joissa näitä ei muuten olisi saatavilla. Toisaalta, etälääketiedeteknologia voi osoittautua hyödylliseksi terveydenhuollon yksiköille, niiden etsiessä kustannussäästöjä tai halutessa parantaa palveluiden laatua potilailleen.

Vaikka etälääketieteen mahdollistava informaatioteknologia on kehittynyt valtavan nopealla tahdilla, on sen käytön yleistyminen terveydenhuollon organisaatiossa ollut tähän asti vaatimatonta. Etälääketieteen käyttöönotosta ja teknologian hyväksynnästä on tehty useita tutkimuksia, mutta valtaosaa näiden tuloksista ei ole voitu yleistää tutkimusten kapean näkökulman johdosta. Etälääketiedejärjestelmien käyttöönotolle ei vieläkään ole esitelty parhaita käytäntöjä tai vahvaa näyttöä kriteereille, jotka tulisi ottaa huomioon etälääketeknologioita kehitettäessä, käyttöönotettaessa sekä käytettäessä.

Tämän tutkielman tarkoituksena parantaa ymmärrystä etälääketieteen käyttöönottoon liittyvistä tekijöistä yksilö- sekä organisaatiotasolla. Näiden etälääketieteen yleistymiseen vaikuttavien tekijöiden tutkimiseksi tutkielmassa tarkastellaan kuutta tapaustutkimusta etälääketieteen kehityksestä, käyttöönotosta ja käytöstä suomalaisissa terveydenhuollon organisaatioissa. Empiirinen tutkimusaineisto on kerätty puolistrukturoiduilla haastatteluilla, joiden löydöksiä peilataan aiempiin akateemisiin tutkimuksiin etälääketieteen käyttöönotosta.

Tutkielman keskeisimmät löydökset viittaavat siihen, että etälääketeknologian tuomien hyötyjen esiteltävyys, orgaanisaatiorakenteet jotka mahdollistavat etälääketieteen käytön päivittäisessä toiminnassa sekä henkilökunnalle riittävän ajan kohdentaminen etälääketieteen käyttöön vaikuttavat eniten etälääketeknologian käyttöönottoon. Toisaalta, olemassa olevia rakenteita suojeleva organisaatiokulttuuri sekä epäselvät teknologian hyödyt saattavat hidastaa etälääketieteen yleistymistä terveydenhuollon yksiöissä.

Avainsanat Etälääketiede, terveydenhuolto, teknologian hyväksyntä, tietojärjestelmät

Table of Contents

1 Introduction 1

1.1 Defining Telemedicine 2

1.2 The Diffusion of Telemedicine Technology 3

1.3 Structure of the Thesis 4

1.4 Research Gap 4

1.5 Research Objective 5

2 Theoretical Background 6

2.1 Overview of Technology Adoption Studies 6

2.2 The Technology-Organization-Environment Framework 7

2.2.1 Technological Context 7

2.2.2 Organizational Context 8

2.2.3 Environmental Context 9

2.3 The Technology Acceptance Model 10

2.3.1 Perceived Usefulness 11

2.3.2 Perceived Ease of Use 11

2.4 The Diffusion of Innovations 13

2.4.1 The Innovation-Decision Process 14

2.4.2 Determinants of Rate of Adoption 15

2.5 The Knowledge Barrier Approach 19

2.6 Research Model 21

3 Methodology 24

3.1 Research Paradigm 24

3.2 Research Design 26

3.2.1 Case Study Research 27

3.2.2 Analysis Design 29

3.3 Data Collection and Characterization 30

3.4 Research Ethics 32

4 Findings 33

4.1 Technological Context Factors 33

4.1.1 Perceived Usefulness of Telemedicine 33

4.1.2 Perceived Ease-of-Use of Telemedicine 35

4.1.3 Perceived Attributes of Telemedicine 36

4.2 Organizational Context Factors 40
4.2.1 Technical Knowledge Barrier 40
4.2.2 Economic Knowledge Barrier 41
4.2.3 Organizational Knowledge Barrier 43
4.2.4 Social Influence 44
4.3 Environmental Context Factors 45
4.3.1 Industry Characteristics 45
4.3.2 Government Role 45
4.3.3 Technology Infrastructure 46
4.3.4 Culture 47
4.4 Decision-Making Factors 48
5 Discussion and Conclusions 50
5.1 Summary of Findings 50
5.2 Empirically Reviewed Framework 52
5.3 Discussion 53
5.4 Theoretical Implications 54
5.5 Managerial Implications 55
6 Study Limitations and Propositions for Future Research 56
References 57
Appendix A: Interview Questions (Translated from Finnish) 64

List of Figures

Figure 1. Basic Concept Underlying User Acceptance Models (Venkatesh et al., 2003) *6*

Figure 2. The Technology–Organization–Environment Framework (adapted from Baker, 2012) *7*

Figure 3. The Technology Acceptance Model (Davis et al., 1989) *10*

Figure 4. Adopter Categorization Based on Innovativeness (Rogers., 1983, p. 247) *14*

Figure 5. A Model of Stages in the Innovation-Decision Process (adapted from Rogers, 1983, p. 165) *15*

Figure 6. A Paradigm of Variables Determining the Rate of Adoption of Innovations (Rogers, 1983, p. 233) *16*

Figure 7. Research Model: A Modified Technology–Organization–Environment Framework (Baker, 2012) *23*

Figure 8. Case Study Method (Yin, 2009, p. 57) *28*

Figure 9. Empirically Reviewed Research Model of Factors Influencing Telemedicine Diffusion *52*

List of Tables

Table 1: Knowledge Barriers to Diffusion of Telemedicine (adapted from Tanriverdi & Iacono, 1999) *20*

Table 2: Basic Beliefs (Metaphysics) of Alternative Inquiry Paradigms (Denzin & Lincoln, 1994, p. 109) *25*

Table 3: The Interviewees and Their Areas of Expertise *31*

1 Introduction

The use of information and communication technology has increased substantially in many industries for the past decades. Despite the increasing prevalence in service digitalization, ICT is still not widely used in clinical healthcare practices. The delivery of conventional healthcare services has traditionally been tightly connected with the knowledge of the treating personnel because diagnoses and treatments cannot be performed without the presence of both patient and the doctor. Some healthcare procedures might require expertise which is not readily available within a reasonable distance.

Telemedicine enables the distribution of medical knowledge from one to many. It gives access to the skill-set of professionals otherwise not available in the location where his or her expertise is needed. Medical education and training are time consuming processes and often the occurring special needs cannot be met with a timely supply of appropriate medical expertise. Bringing the specialist knowledge digitally available eases the burden of personnel costs in healthcare institutions making the scarce specialist knowledge more readily available.

The initial applications of telemedicine emerged in the 1940's when radiological images were transmitted over phone line between two different U.S. healthcare institutions (Field, 1996, pp. 36). By the 1950's, the very first application of a teleradiology system was created by two Canadian radiologists. Ever since then, the development of telemedicine has been going on through the decades. Yet, the ambitious telemedicine projects have so far failed to root the continuous use of telecommunications technology into the common healthcare practices (Zanaboni & Wootton, 2012; Yellowlees, 2005). The decline has been accounted mostly due to high costs of telecommunication systems, expensive data transfer costs and non-user-friendly technologies (Thrall, 2007).

The rise of commercial Internet in the 1990's, allowed telemedicine applications to overcome the former economic and technological limitations (Yellowlees, 2005). Powered by the increased connection speeds, lowered data transfer costs and exponentially multiplying computing speeds, telemedicine is now able to gain foothold in the deeply stabilized practices of healthcare (Yellowlees, 2005; Zanaboni & Wootton, 2012).

Many scholars agree that the global healthcare industry is subject to a turbulent change in the upcoming years (e.g. Yellowlees, 2005; Rho et al. 2014). Yellowlees (2005)

noted that healthcare is moving from sporadically occurring and institutionalized care to an information-based industry, where preventive care is at the core of its offering. Following these notions, several authors have predicted the rise of on-demand medical services and emphasized the importance of self-created data of the service users (Zanaboni & Wootton, 2012; Sanders et al., 2012).

Telemedicine can be utilized in various healthcare activities. In mobile technology, the doctor-to-patient consumer applications have increased rapidly in the past few years. Health technology industry has witnessed new telemedicine-utilizing medical hardware being frantically introduced to the market and developed globally by high-technology companies. In the information and communications field, doctor-to-doctor teleconsultations have opened new possibilities to extend the expertise of healthcare professionals beyond the physical and geological boundaries.

1.1 Defining Telemedicine

In literature, the term "telemedicine" falls under its umbrella term "telehealth" (Van Dyk, 2014). Telemedicine refers to all remote medical interaction done between two or more physically separate entities using different means of telecommunications. At the very core of telemedicine is the exchange of information over a telecommunication platform between two or more geographically separated parties. Roughly, telemedicine can be characterized as a process of clinical information exchange.

Telemedicine in this study refers to all actions where telecommunications are used in a medical setting. Furthermore, telemedicine applications and telemedicine systems refer to all medical equipment, software and telecommunication platforms utilized specifically in delivering the telemedicine services. For the sake of clarity, it is important to make distinction between the terms "telemedicine" and "telehealth". Both terms refer to a seemingly similar matter, but have a notable difference in their meanings. The Oxford Dictionaries (2016) defines telemedicine as *"The remote diagnosis and treatment of patients by means of telecommunication technologies"*. Telemedicine refers to clinical information exchange while the terms "telehealth", "ehealth" and "mhealth" are the activities maintaining and improving the general health of a person by using digital platforms.

The rate of complexity between different telemedicine technologies varies greatly ranging from simple file exchange between two medical entities to complex nation-wide medical record management and exchange systems (Grigsby et al., 2002). A survey conducted by the World Health Organization (2010) states that the most common applications of telemedicine services are in teleradiology, telepathology, teledermatology and telepsychiatry.

1.2 The Diffusion of Telemedicine Technology

Different telemedicine applications have been utilized in healthcare institutions for decades, but so far telemedicine has not gained notable success in substituting or effectively complementing the traditional healthcare practices. The technological attributes and the data transfer costs do not set indomitable limitations for the performance of telemedicine services any more (Yellowlees, 2005). This evidently proposes that reasons for the modest diffusion of telemedicine technology should also be sought outside economic and technological contexts.

Despite the great recent proceedings in the health technology industry, researcher Liezl van Dyk (2014) has pointed out that the success rate of telemedicine services has so far been disappointing. Many telemedicine projects have been seemingly successful at their initial phase, but have eventually failed to be implemented in a sustainable manner after the pilot phase is over. Van Dyk (2014) reasons that the complexity of telemedicine services is often overlooked by the organizations and the challenges in involving two or more organizational entities in the implementation process are not properly confronted. Researchers Grisby et al. (2002) furthermore suggest that as telemedicine implementations still lack the best practices, the organizations are repeatedly stumbling in the same pitfalls. In this vein, Yellowlees (2005) argues that probably the biggest loss for the telemedicine industry and its adoption might be related to its scarred reputation from the earlier failures.

On a global scale, a global eHealth survey conducted by the World Health Organization (2010) showed that 25% out of 112 countries had a national telemedicine policy or a strategy and merely 20% of the countries have fully implemented a said policy or strategy. The proportion of the countries who have initiated any national telemedicine strategy or policy is substantially higher in the developed world than among the developing countries (WHO, 2010).

1.3 Structure of the Thesis

This thesis is divided in six sections: The introduction chapter builds the setting for the thesis subject and introduces the reader to the concept of telemedicine. In this chapter, the research objectives and main contributions to the academic literature are addressed. The second chapter presents the relevant academic literature and shapes the theoretical background for the research. A research model is built upon the findings from the literature review and presented at the end of this chapter. In the third chapter, the research methodology and research data are presented and discussed. The fourth chapter presents the findings of the empirical data analysis. In the fifth chapter, the conclusions are drawn and discussed from the findings of the analysis. Managerial as well as theoretical implications are subsequently presented. In the final chapter, the study limitations and directions for the future research are addressed.

1.4 Research Gap

Telemedicine technology implementation has been rather extensively covered in academic literature during the recent years. In a literature search conducted by Liezl van Dyk (2014), a total of 491 papers were found on telehealth, telemedicine and related concepts. Despite this, the academics agree that telemedicine industry still lacks standardized service models, technologies and best practices (Grigsby et al., 2002; Zanaboni & Wootton, 2012). Furthermore, telemedicine technologies differ from each other significantly, as the requirements for the services vary greatly between the medical specialties (Tanriverdi & Iacono, 1999). The academic research of telemedicine is burdened with this complexity and suffers from difficulties in yielding generalizable results (Zanaboni & Wootton, 2012). In addition, the national regulations of healthcare may differ significantly from country to country and it might be next to impossible to make reasonable generalizations between them (Grigsby et al., 2002).

The institutionalized nature of healthcare organizations and stringently regulated clinical practices might differ a lot from conventional business organizations (Yarbrough & Smith, 2007). It should be carefully evaluated whether the traditional technology adoption models are suitable for explaining the adoption process of telemedicine systems and applications. In academic literature, telemedicine adoption has been researched using various adoption models, such as the Technology Acceptance Model (e.g. Chau & Hu,

2002; Hu & Chau 1999; Melas et al., 2011), Diffusion of Innovations framework (e.g. Grigsby et al., 2002), and less frequently: Theory of Planned Behavior (e.g. Hsieh, 2015), Theory of Interpersonal Behavior (Gagnon et al., 2013), Normalization Process Theory (May et al., 2003) and the Logical Framework Approach (Chang, 2015). The academic research of telemedicine adoption is still not very exhaustive as opposed to technology adoption studies in general. Many different approaches to telemedicine adoption have been utilized in the existing literature, but a review conducted by Liezl van Dyk (2014) revealed that the studies still lack a holistic approach for the successful implementation of telemedicine technology.

1.5 Research Objective

The main objective of this thesis is to identify and analyze the factors influencing the adoption of telemedicine technologies. The subject is covered by studying the relevant technology adoption theories and reflecting empirically collected data with the insight given by them. Based on the findings from the empirical data, the study aims to provide practical implications for telemedicine service developers, providers and adopters. Further on, the study is expected to yield implications for the future research and give suggestions for the topics of interest that should be taken into closer inspection. These notions construct the baseline for the research questions of this study:

1. *What are the main factors influencing the adoption of telemedicine technology in healthcare organizations?*
2. *How should these factors be considered in telemedicine system development, deployment and use?*

2 Theoretical Background

This chapter is presenting the earlier research of telemedicine service adoption. These theories and findings are utilized in forming the theoretical background of the thesis and furthermore aimed to present a logical framework for the analysis. At the end of this chapter, a research model is proposed to provide a guideline for the analysis of the empirical data.

2.1 Overview of Technology Adoption Studies

Researchers Oliveira and Martins (2011) suggest that the most commonly used technology adoption models can roughly be divided into two categories: (1) Individual adoption models, drawing mainly from the psychological & behavioral sciences, and (2) organizational adoption models, placing higher emphasis on social science studies. However, the underlying ideas between the theories in both categories are similar.

Majority of the technology adoption research, both individual and organizational adoption, has been focusing on the user acceptance models (Oliveira & Martins, 2011) which essentially follow a rationale that attitudes and previous experiences set the basis for the intentions to use and to eventually use a technology. Figure 1 illustrates the concept behind the user acceptance models, as presented by Venkatesh et al. (2003).

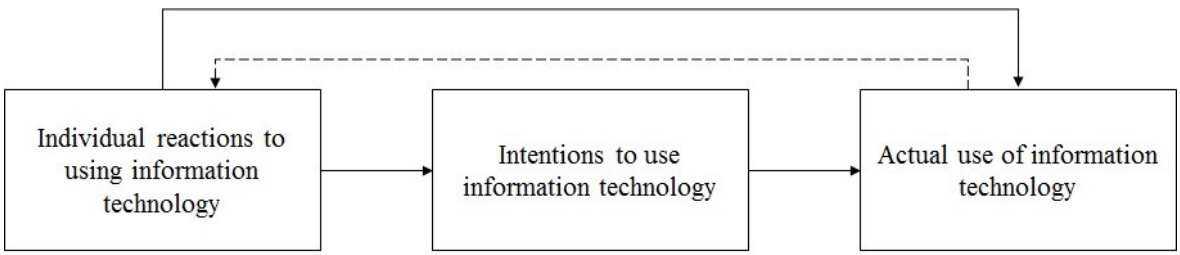

Figure 1. Basic Concept Underlying User Acceptance Models (Venkatesh et al., 2003)

Although the basic concept with different individual user acceptance models follows the same rationale, the notable differences between various models arise from different interpretations on the determining or moderating factors of the said attitudes and experiences. Additionally, the scope of interest varies between different adoption models. Some models emphasize the past experiences as the source of the attitudes towards a technology consequently affecting the intentions to use a technology. Other models set

their time scope to future expectations to be achieved through the adoption or rejection of the technology (e.g. TAM and Knowledge Barrier Approach). Moreover, some models focus on a single adoption decision, while other models view the adoption decisions as series of events inside a social system (e.g. Diffusion of Innovations).

2.2 The Technology-Organization-Environment Framework

The TOE Framework was originally developed by DePietro et al. (1990), but due to the unavailability of the original text, the framework in this thesis is described based on Jeff Baker's (2012) article on TOE framework. The framework describes the technology adoption decisions of an organization to be influenced by three elements: Technological context, Organizational context and Environmental context (DePietro et al., 1990; Baker, 2012). Together these contexts frame how the organization identifies the need for new technology, seeks new technology or adopts new technology (Baker, 2012). In other words, the technological innovativeness of the organization is influenced by these three elements.

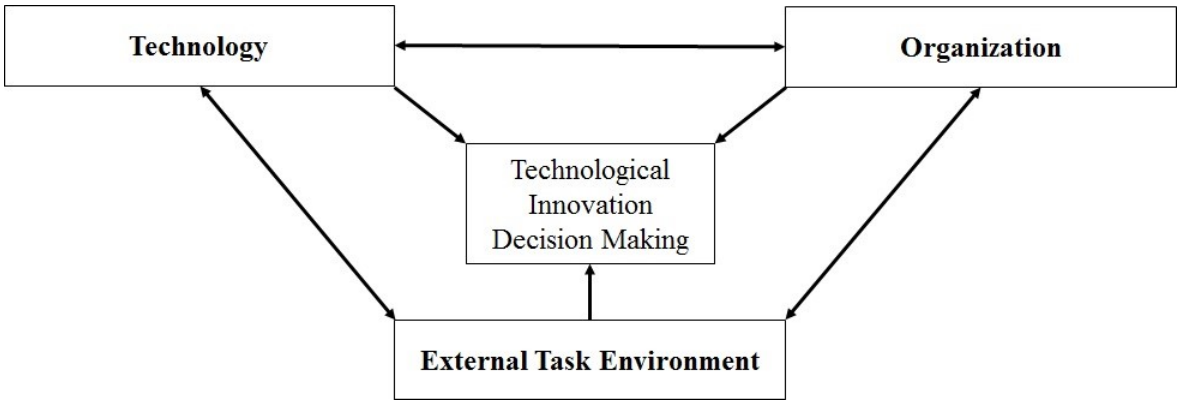

Figure 2. The Technology–Organization–Environment Framework (adapted from Baker, 2012)

2.2.1 Technological Context

Baker (2012) describes the technological context to entail all internal and external technologies that are relevant for the organization whether they are already being used by the organization or not. The internal technologies currently in use in the organization are related to any new technological adoption, as they set limitations to the opportunities and speed of which the new technologies can be adopted. Following the views of Everett Rogers (1983, p. 233), new technology compatibility is a relevant factor in the speed of the adoption and is evaluated by the potential adopters based on the organization's existing technologies.

Innovations can be categorized by their level of novelty and relationship with existing technologies. A widely-used dichotomy presented by Ettlie et al. (1984) divides innovations in two categories; incremental and radical innovations. Incremental innovations are new products, processes, technologies or ideas, which evolve the old ideas bringing minor, accumulating changes in them. Radical innovations are discontinuous innovations that disrupt the previous structures and processes presenting a whole new idea of performing a certain task (Ettlie et al., 1984, Baker, 2012). On this note, researchers Yarbrough & Smith (2007) have proposed that healthcare technologies which interfere as little as possible with the Physician's existing working routine are more likely to be adopted.

Grigsby et al. (2002) characterize telemedicine as radical innovation, which is likely to challenge the rules and norms in the traditional healthcare organizations and their processes. The nature of telemedicine as radical innovation might therefore present a major challenge to be implemented especially in public healthcare organizations which typically operate in a customary and institutionalized environment (Omachonu & Einspruch, 2010). In addition, Ettlie et al. (1984) point out that radical innovations often incorporate economical and operational risks to the organizations as their implementation requires the existing services or processes to be changed radically or even removed completely.

2.2.2 Organizational Context

The organizational context includes the internal processes, skills, knowledge and infrastructure of the organization (Baker, 2012). The factors posed in the organizational context set the limitations, but also possibilities for the organization to be open to change and adopt novel ways of performing its operations.

The organization's ability to adopt and process new information is dependent on the organization's ability to learn through organizational learning (Tanriverdi & Iacono, 1999). Omachonu & Einspruch (2010) highlighted that healthcare organizations are very institutionalized by nature and clinicians are often hard to convince to change their working habits. The implementation of telemedicine systems will require substantial efforts in influencing the organizational behavior and aiding the organizational learning. Researcher Liu (2011) has proposed a way aiding the implementation of a telemedicine

systems by encouraging the staff to participate in telemedicine conferences and projects that involve high technology services in healthcare.

Grigsby et al. (2002) have proposed that the organizational adoption of telemedicine is also influenced by the institutional authority commanding the organization and its authority to make telemedicine use obligatory. This would explain the higher use rates of telemedicine in organizations which exercise high institutional controlling, such as the military or correctional facilities (Grigsby et al., 2002). Nevertheless, researchers Zanaboni and Wootton (2012) note that without proper managerial and individual commitment, telemedicine usage imposed by authoritative decisions might be short-lived and deemed to end abruptly after the monetary support for the project runs out.

2.2.3 Environmental Context

Environmental context includes factors which are outside the direct influence of the organization but affect its innovation decisions. Baker (2012) categorizes these as: The characteristics of the industry, the government, the market and the technology infrastructure.

Governmental regulations can be either enabling or limiting factor for the telemedicine adoption within the industry (Baker, 2012). North et al. (2014) have studied the adoption barriers for telemedicine based on the governmental regulations. The researchers recognized national medical quality measures to be a barrier in telemedicine implementation as medical quality standards might pose limitations to whether patients can be treated using remote appointments. In contrast, Liu (2011) points out that ageing population lowers the amount of productive labor force implying that governments might have an incentive to play an enabling role in developing and promoting the usage of new cost-effective and long-term healthcare services. Indeed, Liu (2011) found evidence that governmental support and supportive policies, e.g. tax-incentives, were expected and relied on by the potential telemedicine adopters.

In addition to the industry characteristics and the role of the government, culture is found affecting the adoption of telemedicine. A study conducted by Mansouri-Rad et al. (2013) found that culture has indirect influence over the telemedicine adoption through information security, privacy and policies. Based on their findings, the researchers rationalize that before attempting to implement telemedicine systems in healthcare

organizations, it is important to analyze and consider the culture under which the system will be implemented.

The TOE framework has been successfully used in various studies across different industries, technologies and cultural contexts with considerable explanatory power over the innovativeness of the research subject (Baker 2012). However, Baker (2012) notes that the empirical studies have modified the factors under the three elements in accordance with the research context in question and highlights that the factors included in the framework should be adjusted to the characteristics of the research subject. Given that TOE is a general framework of the organizational innovation adoption, to fit the concept of telemedicine, the factors for the framework in this study are sought by incorporating existing findings from telemedicine adoption research.

2.3 The Technology Acceptance Model

The Technology Acceptance Model (TAM) was originally introduced by Mr. Fred D. Davis in 1986 in his doctoral dissertation at MIT Sloan School of Management. The model is an adaptation of a widely used general social psychology theory called the Theory of Reasoned Action (Fishbein & Ajzen, 1975). The rationale of the TAM is that the attitude towards certain behavior is formed through a cognitive process of how the intended behavior might improve the performance of the user (Davis et al, 1989). Even though external variables are included in the model, the original TAM focuses on the subject's perception of the instrumental value of a system to be attained through its use.

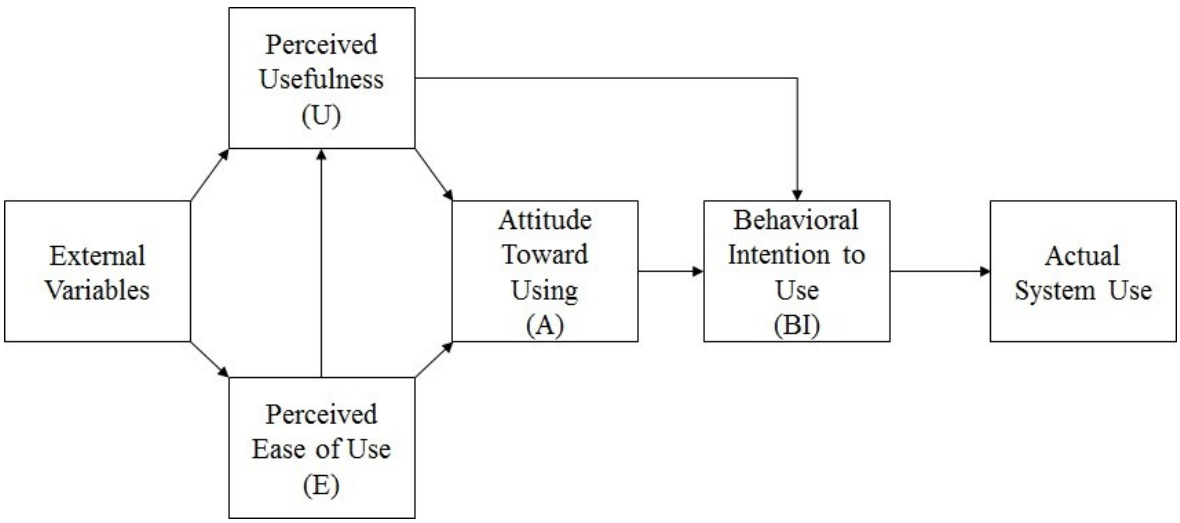

Figure 3. The Technology Acceptance Model (Davis et al., 1989)

The TAM, presented in the Figure 3, has been built for a very specific purpose of predicting the behavior to use information systems. The model emerged from a need to generate a tool to explain user acceptance of computer systems and has gained notable popularity in the technology adoption research due to its simplicity and ease of use. In its basic form, the theory leans on two determinants that influence the individual's attitude towards a system use: Perceived Usefulness and Perceived Ease of Use (Davis, 1989; Davis et al., 1989).

2.3.1 Perceived Usefulness

Perceived Usefulness tells to what extent the subject thinks that using a system or a new technology will help the person to enhance his or her job performance (Davis, 1989). In other words, the subject will evaluate whether using the technology in question would make his or her job more efficient. The theory poses an assumption that high Perceived Usefulness of the system influences positively the Behavioral Intention to use the system.

In defining the usefulness in healthcare, Porter and Lee (2013) stated that it should be in the best interest of medical personnel to deliver the health services in a manner which would yield the best possible outcome for the patient. Consequently, the Perceived Usefulness is related to the clinician's view on whether the patient receives better treatment with the use of telemedicine system (Yarbrough & Smith, 2007). In other words, if a potential adopter perceives the telemedicine system to be able to enhance his or her work performance, he or she is more likely to use it.

2.3.2 Perceived Ease of Use

Perceived Ease of Use refers to the degree of how laborious task the subjects perceive using the system to be. A research conducted by Rho at al. (2014) confirmed the individuals evaluate how free of effort is the use of a new system or technology and reflect it with its potential usefulness. A system that requires less effort from the user to learn will be more likely used than a system requiring more laborious effort from the user (Davis, 1989; Venkatesh, 2000). Following this view, potential users might see the benefits of the new system or technology, but these benefits might be outweighed by the laborious efforts needed to be taken before the system can be used.

Davis (1989) conducted a research on the relative strengths of the original two determinants of the TAM. The results show that a stronger link was present between

Perceived Usefulness and Actual Systems Use than between the Perceived Ease of Use and Actual Systems Use. This finding implies that individuals are willing to tolerate some difficulties in using a system, if they feel that the system otherwise performs an essential task in their job.

The assumed positive relationship of Perceived Usefulness and Behavioral Intention to Use posed in TAM has been confirmed by Hu et al. (1999) who studied the Physicians' acceptance of telemedicine technology. The researchers discovered that the Perceived Usefulness had a significant and strong influence over the physician's Behavioral Intention to Use telemedicine technology. Based on this, Hu et al. (1999) propose that it is crucial to demonstrate the usefulness of telemedicine technology to increase its acceptance.

The original assumptions posed in the TAM were later confirmed also in another medical setting by researchers Rho et al. (2014), who studied the predictive factors of telemedicine acceptance by surveying 183 Physicians. They found evidence that Perceived Usefulness of telemedicine services impacted the Behavioral Intention to use them, and the Perceived Ease of Use impacted directly both the Perceived Usefulness and the Behavioral Intention to use the services. In other words, if telemedicine services are seen useful, the Physicians are more likely to adopt them. Furthermore, the service being perceived as easy to use will additionally increase its supposed usefulness by the Physicians, making the likelihood of adopting the services even higher.

The TAM has been criticized for oversimplifying the complex adoption process (e.g. Hart et al., 2010; Yarbrough & Smith, 2007). A literature review by Hart et al. (2010) reveals that the critiques of the TAM point out the shortfalls of the model in providing meaningful information of the prospective user's opinions about the technology to be adopted. Kieran Mathieson (1991), studied the differences between the TAM and another adoption model, Theory of Planned Behavior (TPB), and noted that both models were adequate to predict and explain the adoption of a certain technology by themselves, but when used together they could provide more insightful information for the researchers. The TAM alone is best suited in predicting whether the subjects use the system or not without providing much information about the reasons for their behavior. Nonetheless, the TAM is generally accepted to predict the variance in technology acceptance even as a standalone model (Yarbrough & Smith, 2007). For more meaningful analysis and to increase its explanatory power, the TAM should be accompanied with either other

incorporated factors (Hart et al. 2010; Hu & Chau, 1999), content-specific variables (Yarbrough & Smith, 2007) or with other IT adoption models (Mathieson, 1991).

The original TAM presents an assumption of two determinants impacting the attitudes towards using a system. To avoid the potential shortcomings of the TAM in predicting telemedicine adoption, several studies have later extended the theory by studying the variables impacting the usefulness and the ease of use in healthcare context (Yarbrough & Smith, 2007). An example of these context-specific variables can be found in the study by Rho et al. (2014), who introduced three telemedicine-specific variables, which have an influence over the original TAM determinants: Accessibility of Medical Records and Accessibility of Patients had significant impact on the Perceived Usefulness of telemedicine services. The third factor, Self-Efficacy (users' own capability to use the system) influenced positively the Perceived Ease of Use and Perceived Usefulness.

Healthcare industries might differ substantially from traditional business industries in terms of its regulations, processes, organizational structures and business models (Yarbrough & Smith, 2007). Even though the TAM is deemed almost as a paradigm theory in the IT acceptance studies, researchers Holden & Karsh (2009) noted that the model in its basic form might leave out or even contradict with some of the context-specific factors present in the healthcare industry. The concerns about the TAM's suitability to predict technology adoption in the healthcare context have been addressed in numerous studies (e.g. Holden & Karsh, 2010; Hu et al., 1999; Melas et al., 2001; Rho et al., 2014 and Sezgin et al., 2014) with most of the research concluding that despite its simplicity, the model performs reasonably well in predicting the use and adoption of telemedicine technology (Holden & Karsh, 2010; Yarbrough & Smith, 2007).

2.4 The Diffusion of Innovations

Another dominant theory in technology adoption studies is the theory of Diffusion of Innovations (DOI) by Mr. Everett Rogers (1983). In his seminal book, "Diffusion of Innovations", Rogers (1983) proposed an approach that the innovations are adopted or rejected through informed decisions based on the information about the innovation features, communicated through a social system in a certain amount of time (Rogers, 1983, p. 5). The disparity of information about the features of the innovation is the key source for the famous S-Curve often associated with the Diffusion of Innovations theory (Rogers,

1983, p. 244). The theory suggests that when the uncertainty about the innovation lessens, the stronger the diffusion will be.

Rogers categorized the adopters by the time it takes them to adopt or reject the innovation (Rogers, 1983, p. 205). Figure 4 presents Rogers' categorization of the adopters relative to the cumulative volume of how much the innovation has already been diffused over time. The first ones to adopt an innovation are called the Innovators. These are followed by Early Adopters, Early Majority, Late Majority and finally Laggards. As the time goes on and the information about the innovation's features continues to spread through the social system, the theory proposes that potential adopters will continue adopt the innovation until the market is fully saturated.

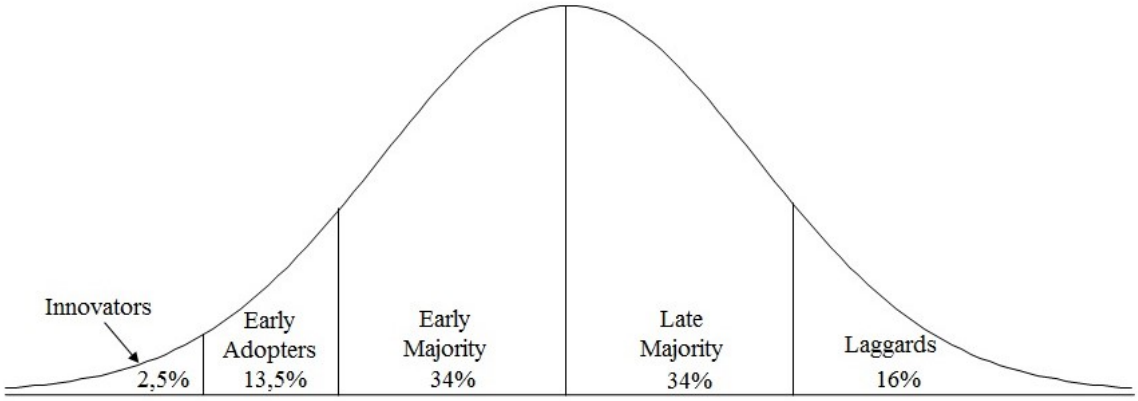

Figure 4. Adopter Categorization Based on Innovativeness (Rogers., 1983, p. 247)

Researchers Zanaboni and Wootton (2012) studied the relationship of telemedicine diffusion with other technologies and posed an assumption that along with other healthcare technologies, the adoption of telemedicine technologies follows the same logarithmic S-curve as the Diffusion of Innovations theory suggests. Furthermore, it has been argued that at its present stage, telemedicine service adoption rate has now surpassed the Early Adopters and is currently attracting interest of the Early Majority (Van Dyk, 2014).

2.4.1 The Innovation-Decision Process

The rationale in the Diffusion of Innovations theory is that innovations always employ some level of uncertainty in the minds of potential adopters. Rogers (1983, p. 35.) referred this as *innovation evaluation information*. A higher level of evaluation information alleviates the uncertainty associated with the innovation which will eventually lead to the informed decision to adopt or reject the innovation.

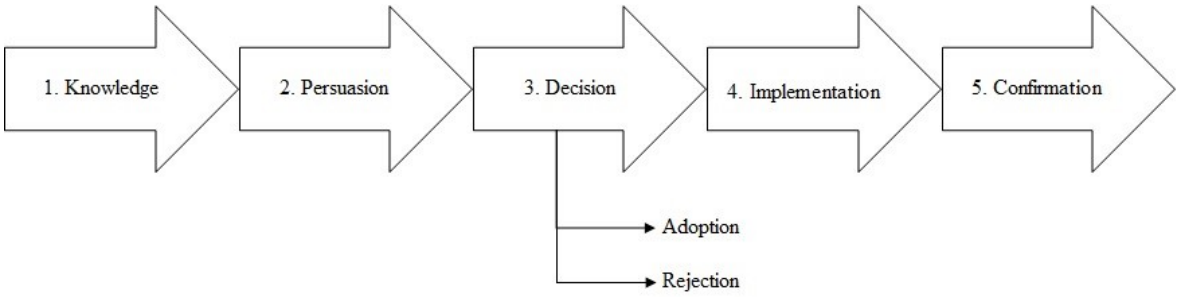

Figure 5. A Model of Stages in the Innovation-Decision Process (adapted from Rogers, 1983, p. 165)

The potential adopters of an innovation pass through certain phases before being able to form informed decisions whether to adopt or reject the innovation (Rogers, 1983, p. 206; Frambach, 1993). Figure 5 presents a simplified model of an innovation-decision process which starts when an organization or individual comes acquainted with the information about the innovation. In the second stage, the subject forms an opinion whether to adopt the innovation or not. If the decision is positive, the innovation is implemented in the organization or individual's practices and one sequence of innovation diffusion has occurred (Frambach, 1993).

The diffusion paradigm poses an assumption that the higher the information of the innovation features is, the faster the adoption or rejection will be. In the "Persuasion" phase, which leads to the formation of the decision, the perceived attributes of the innovation, determine this rate. The decision of the adoption or rejection is affected by the amount of information, the quality of this information and its value to the potential adopter (Frambach, 1993). To be able to make informed decisions about telemedicine technology adoptions, this implies that the usefulness of the technology should be effectively communicated to the potential adopters which supports the arguments posed in the TAM (Davis, 1989; Hu et al., 1999).

2.4.2 Determinants of Rate of Adoption

The rate of adoption is the speed of the diffusion through a social system (Rogers, 1983, p. 232-233). This speed is affected by several attributes depending on the qualities of the innovation and the context where the diffusion is happening. All innovations and their diffusion systems have different features and generalizations between them is difficult to make. Rogers has identified five commonly applicable determinants which have the most significant impact on the diffusion. These attributes are presented in Figure 6:

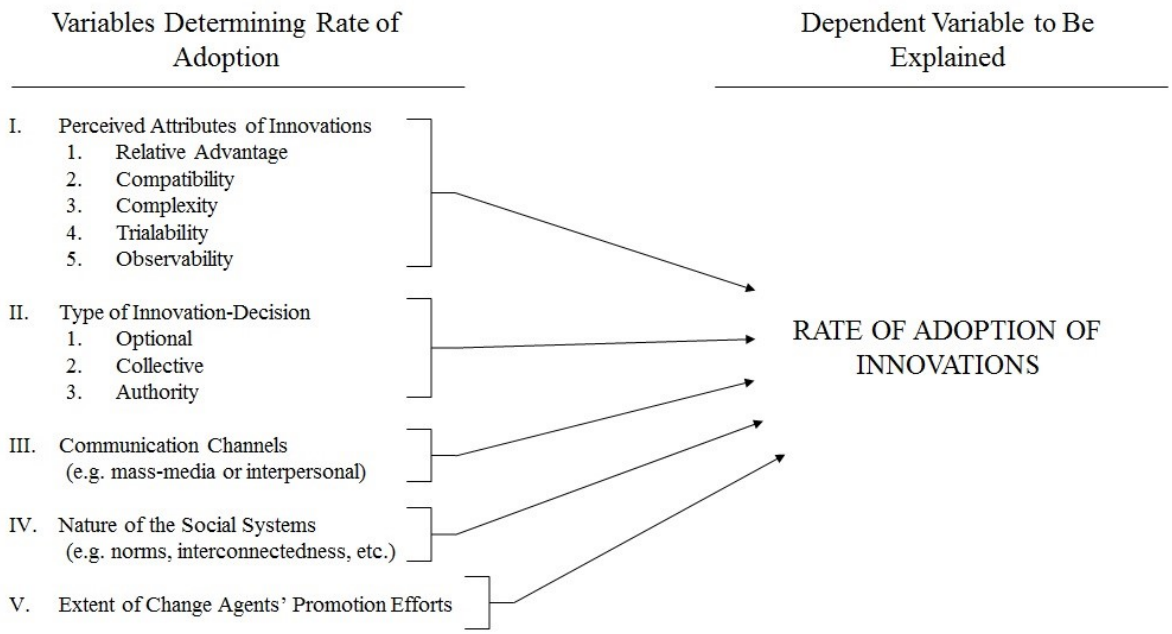

Figure 6. A Paradigm of Variables Determining the Rate of Adoption of Innovations (Rogers, 1983, p. 233)

The most common determinant of the rate of adoption is the innovation's perceived attributes. The first attribute, The Relative Advantage is the level of how effectively the innovation supersedes the previous ideas, practices, or technologies (Rogers, 1983, p. 217; Cain & Mittman 2002). A study conducted by Zanaboni and Wootton (2012) concluded that out of the five Perceived Attributes of Innovations, the Relative Advantage has the most significant impact to the rate of adoption. The nature of Relative Advantage depends on the position of the adopter and its importance depends on what is sought to be achieved through the adoption (Rogers, 1983, p. 217).

The second attribute, Compatibility, refers to the extent of how compatible the innovation is with the past experiences, existing values and the needs of a potential adopter (Rogers, 1983, p. 223) The attribute tells whether, for example, a new telemedicine system would be compliant with the existing patient record systems in a hospital, or a new remote treatment procedure compliant with previous, traditional process of getting treatment from the family doctor.

The perceived Complexity tells how difficult an innovation is to understand and use by potential adopters. Rogers (1983, p. 231) argues that higher Complexity correlates with a lesser rate of adoption, which is in line with the assumptions posed in TAM's Perceived Ease of Use (Davis, 1989). If the innovation requires substantial learning from the potential user, it is less likely to be adopted by individuals (Cain & Mittman, 2002).

Implementing a telehealth service is often a task of high Complexity which entails elements from technological issues to legislative issues, infrastructure building and change management in organizations (van Dyk, 2014).

Innovation's Trialability is the level of how easily the innovation can be tested prior a larger scale implementation without extensive commitment from the adopter (Rogers, 1983, p. 231). The original assumption in the Diffusion of Innovations theory is that if the innovation can be easily trialed, it will be more likely to be adopted (Rogers, 1983, p. 231). Innovations entail a relatively high risk as compared with standardized products and services. The Trialability is especially important for the early adopters, when the information about the innovation is still limited. Smaller scale test runs do not entail as substantial costs of failure. Apart from organizational risks associated with telemedicine adoption, Hsieh (2015) identified perceived risks of the Physicians in categories related to their personal performance risks as clinicians, psychological risks related to their self-perception and patient data privacy risks associated with possible data leakages.

The perceived Observability tells how visible and communicable the characteristics of the innovation are to other members inside the adopter's social system (Rogers, 1983, p. 232). Rogers suggests that the easier the benefits of an innovation are to be seen by other member of the system, the higher the rate of adoption will be. Authors Cain and Mittman (2002) point out that some innovations might take a long period before its benefits can be observed. In healthcare, these are typically innovations that aim lessening the recurrence of some medical condition of the patients (Cain & Mittman, 2002).

Apart from the innovation's perceived attributes, Rogers (1983) argue that the type of the decision making inside the organization's social system affects the rate of adoption. Diffusion systems employing Optional decision-making allow members of the system to make individual decisions independently from other members. In a Collective decision-making system, several participants make the adoption or rejection decision mutually. Further on, Authority decision-systems involve relatively few individuals in a system that possess an authoritarian power to make the decisions of adopt or not to adopt an innovation. Rogers (1983, p. 233) proposes that the rate of adoption is higher, the lesser participants the decision making involves and the higher the freedom of choice the decision makers possess. In their research, Zanaboni and Wootton (2012) later confirmed

that voluntariness in adoption contributed positively in several telemedicine programs and induced continuity in the systems use.

Rogers (1983, p. 233) notes that the rate of adoption is also affected by the choice of the communication channels. Following on the propositions posed by Hu et al. (1999), the communication channels should be chosen based on their effectiveness to communicate the Perceived Usefulness of telemedicine technology to the potential adopters. Cain and Mittelman (2002) distinguished the appropriate choices of communication channels in healthcare innovations based on the target of the communication efforts. To increase the knowledge about the innovation, the communication should happen through means which cover high volumes of potential receivers, such as mass media. Additionally, to induce the persuasion of adopting the said innovation, interpersonal and social channels should be used (Cain & Mittelman, 2002).

Researchers Grigsby et al. (2002) studied the theory of Diffusion of Innovations and its application to telemedicine. Their major notion is that all the potential adopters do not inevitably benefit from an innovation, such as telemedicine technology. The adoption decision is always dependent on the context, the type and the situation of a potential adopting organization. In a larger scale, evaluating the contextual setting of the organization is instrumental in understanding the factors affecting the telemedicine adoption. Grigsby et al. (2002) further argue that the diffusion of telemedicine is moderated by factors that can be categorized as economic, societal, organizational and individual factors.

Different industries and organizations have various diffusion systems which can be categorized into Centralized and Decentralized systems (Rogers, 1983, p. 335). In a Centralized system, the communication is based on a linear one-way communication. Decentralized systems employ creating and sharing the information across the system and the members of the system can control the diffusion process themselves. Assumption posed in Roger's (1983) work, is that centralized systems are less innovative than decentralized systems which exert less hierarchical control over the innovation process. A systematic review by Greenhalgh et al. (2004) studied Structural Determinants of organizational innovativeness and found evidence that the level of centralization has a significant negative impact to organizational innovativeness. In other words, the less

concentrated the decision-making autonomy in an organization is, the more innovative the organization is and likely to adopt new technologies.

2.5 The Knowledge Barrier Approach

The theory of Diffusion of Innovations (Rogers, 1983) was originally developed to predict the spreading of innovations. The theory's main assumption is that the speed of diffusion can be explained by differences between the potential adopter's perceived attributes of the innovation and the actual features of the said innovation. This assumption was called for, since by the time the model was originally developed, these innovations mainly comprised of comprehensible physical products rather than intricate technological systems.

To avoid the potential shortcomings of the earlier adoption models in their suitability to predict the diffusion of complex systems, several authors have proposed alternative theories. A theory introduced by Paul Attewell (1992), the Theory of Knowledge Barriers, proposed that the organization's lack of knowledge and technological know-how pose the greatest threat to the adoption of new technology. Attewell (1992) emphasized the importance of organizational learning in the adoption process.

Fichman (2000) studied the relationship of the Diffusion of Innovations theory with Attewell's (1992) Knowledge Barrier theory. He concluded that the main difference between the theories is in Attewell's emphasis on structures and institutions aiming to lower the organizational knowledge barriers, instead of assuming the organization's ability to gain the knowledge by itself. Fichman (2000) stresses the importance of organization's ability to invest resources in the knowledge facilitation process. Another notable difference between the theories is that while the Diffusion of Innovations theory focuses on the cognitive processes of the potential adopters before the adoption decision, Attewell's (1992) theory expands the time scope beyond the decision and emphasizes the post-adoption implementation of the technology. Researchers Tanriverdi and Iacono (1999) argue, that while telemedicine developers and vendors are mainly interested the adoption process, the healthcare organizations focus on the long-term prospects of the technology. This argument is in line with the assumption posed in the TAM that potential adopters evaluate the instrumental value of technologies prior to adoption (Davis, 1983).

The Diffusion of Innovations theory assumes that when the potential adopters have acquired enough information about an innovation the adoption decision will eventually happen. Tanriverdi & Iacono (1999) argue that this does not seem to be the case with telemedicine implying that there are other, mainly non-innovation-specific factors, which might affect the adoption. The researchers identified four types of knowledge barriers in telemedicine system adoption. Following Attewell's (1992) seminal work on IT knowledge barriers, Tanriverdi & Iacono (1999) argue, that to establish continuous use and diffusion of telemedicine systems and applications, the organization must overcome technical, economic, organizational and behavioral knowledge barriers.

Table 1: Knowledge Barriers to Diffusion of Telemedicine (adapted from Tanriverdi & Iacono, 1999)

	Knowledge Barrier	Implication to Telemedicine Adoption	Methods to Overcome
1.	**Technical knowledge barrier**	The key-challenge in the adoption of telemedicine technology.	Raise awareness. To establish the use of telemedicine technology, the application should prove evidence of clinical effectiveness.
2.	**Economic knowledge barrier**	There is a lack of standardized and economically viable business models for telemedicine applications.	The requirements of all the stakeholders should be satisfied. The proof of profitability and effectiveness of the new technology should be evident before adoption.
3.	**Organizational knowledge barrier**	Telemedicine implementation requires substantial effort from the organization to build support systems and new working processes.	Develop new organizational processes and integrate them into the organization's culture.
4.	**Behavioral knowledge barrier**	Changes in work-practices, differences in acceptance by physicians.	Guide the implicit process of lowering the barriers by demonstrating; Technical feasibility, clinical effectiveness, cost effectiveness and organizational support of the technology.

Tanriverdi and Iacono (1999) identified the Technical knowledge barrier to be the most significant barrier for telemedicine adoption. Their research concluded that to convince Physicians to adopt telemedicine, evidence about the clinical effectiveness of the technology must be apparent to the Physicians. Pragmatic and authoritative evidence was not sufficient to induce continuous use of telemedicine, but more promising results were

gained by using scientific data about the medical feasibility of the technology (Tanriverdi & Iacono, 1999).

Even though the lack of external reimbursement has been commonly stated as a limiting factor for telemedicine diffusion, Tanriverdi and Iacono (1999) found no evidence on this. The researchers furthermore point out that the challenge with telemedicine technologies is not in its poor economic feasibility, but rather in the lack of knowledge on how telemedicine systems, technologies or other applications should be implemented. This lack of economically viable business models and profitable earning logics proved to be a barrier for telemedicine diffusion (Tanriverdi & Iacono, 1999). Essentially, the researchers conclude that pragmatic knowledge about the economics of telemedicine needs to be supported with scientific evidence.

The third barrier Tanriverdi and Iacono (1999) identified is the organizational knowledge barrier. Successfully implementation of telemedicine systems requires substantial effort to build new organizational structures and integrating them into organizational culture. The researchers emphasized the importance of organizational support services. In the case studies conducted by the researchers, only successful telemedicine projects had put technical, administrative and medical support services in place in the organizations. In addition, these organizations incorporated telemedicine in their existing workflows and promoted its use in daily work.

Finally, Tanriverdi and Iacono (1999) note that the behavioral knowledge barrier poses a challenge in enhancing the individual acceptance of the technology inside the organization. Even though the organization might take all the step necessary for successful telemedicine implementation, the efforts must eventually aim at changing the behavior of the organization's members. All three barriers contribute to the acceptance on the individual level and the researchers conclude that lowering the behavioral knowledge barrier is the combination of the efforts aimed towards encouraging the individuals to use telemedicine technologies.

2.6 Research Model

The research model will provide theoretical background for this thesis and guide the analysis of the empirical data. The model is built upon prior findings from the technology

adoption literature. The foundation of the model is constructed over the TOE framework using its categorization of three basic elements that shape the innovativeness of the organization. Following Baker's (2012) suggestions, the three elements are incorporated with industry-specific factors drawn from the earlier research findings on telemedicine adoption. To avoid the potential shortcomings of building the analysis on a single adoption model and to increase the explanatory power of individual models, the conceptual framework is drawn from the earlier research findings of the adoption theories: The Technology Acceptance Model (TAM), The Diffusion of Innovations (DOI), The Knowledge Barrier Approach.

For the Technology element of the model, attributes from the TAM and the DOI are incorporated in the TOE framework. Perceived Usefulness and Perceived Ease-of-Use were identified by numerous authors to affect individual's willingness to adopt telemedicine technology (e.g. Rho et al., 2014; Hu et al., 1999; Yarbrough & Smith, 2007; Melas et al., 2011). Additionally, as the TAM factors mainly contribute to the perceived instrumental value and attitudes of the adopters, the technology-specific attributes are drawn from the DOI theory emphasizing the characteristics of the telemedicine systems. The Perceived Attributes of telemedicine have been attested by several authors (Cain & Mittman, 2002; Grigsby et al., 2002) to influence the adoption of healthcare technology and telemedicine.

The Organizational element of the model will be covered with findings from the Knowledge Barrier Approach (Tanriverdi & Iacono, 1999). The knowledge barriers explain the adoption through the organization's ability to acquire new knowledge, but the approach does not address the social dynamics of the organizations. Social influence is incorporated in the organization element of the model as both TAM and DOI recognizes it as moderating factor to technology adoption.

The External Task Environment comprises of factors outside the direct influence of the organization. Baker (2012) studied the TOE factors in existing literature and found commonly used environmental factors to be related to the regulatory environment, technological infrastructure and to the industry characteristics. Additionally, Mansouri-Rad et al. (2013) recognized culture to play a part in telemedicine adoption of individuals and organizations.

Finally, the Innovation-Decision Making is identified to be influence by the decision-making structures of the organization. For this element, the DOI theory suggests that decision autonomy contributes to the rate of adoption decisions (Rogers, 1983, p. 233). The type of innovation-decision is included as a moderating factor for telemedicine adoption in the model.

Based on these findings, an integrated research model incorporating the industry specific factors is formed and illustrated in the Figure 7. The purpose of the research model is to give structure for the empirical part of this study and guide the analysis of the factors that potentially influence the adoption of telemedicine. The research model is used to validate whether prior findings from telemedicine adoption literature are in line with the expert interviews conducted in the empirical part of this study. Secondly, the model provides a background for evaluating if new factors outside previous telemedicine research are found through the interviews. Finally, the model is utilized in conceptually evaluating the relative strengths of the factors influencing the adoption.

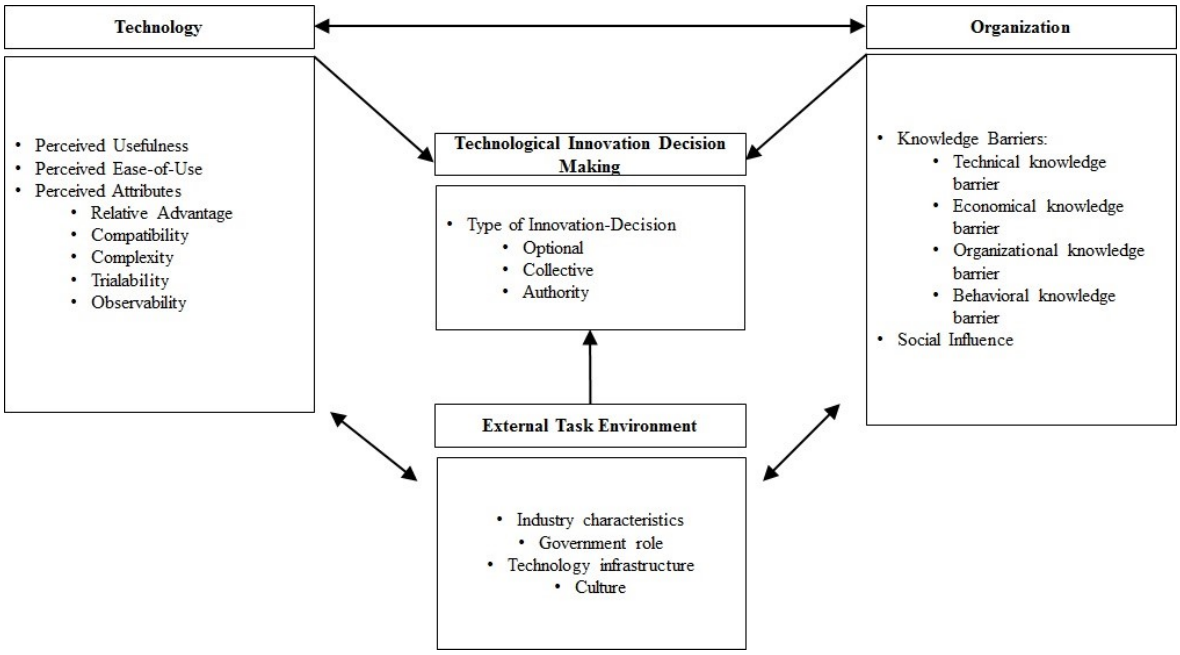

Figure 7. Research Model: A Modified Technology–Organization–Environment Framework (Baker, 2012)

3 Methodology

This chapter describes the research methodology and explains the research fundamentals of the thesis. The first section discusses the choice of research paradigm which lays the foundation for the choice of research method. The second section gives detailed explanation of the research design and provides reasoning for the choices of the research methods. After this, the data collection method and characterizations of the empirical data are discussed. In the final section, research ethics and guidelines are addressed.

3.1 Research Paradigm

Following the views of Egon G. Guba and Yvonna S. Lincoln (1994, p. 105), the question of research method is secondary to the question of identifying the research paradigm for the investigation. The first phase in any research is to identify a research paradigm, which affects the choice of the research methodology, the role of the researcher and ultimately the interpretations of the findings.

Paradigms can be defined as a set of basic beliefs, which dictate the researcher's approach and limitations to the research in question. The research paradigm guides the role of the researcher, the perception of reality and sets boundaries to what falls within valid boundaries of the research (Guba & Lincoln, 1994, p. 108). Each different interpretive framework set different requirements for the researcher. The research paradigm, or interpretive framework (Denzin & Lincoln, 2000, p. 13), is a sum of the researcher's *epistemological*, *ontological* and *methodological* principles.

- Ontology: How is the reality interpreted and what is possible to know about it?
- Epistemology: What is the role of the interpreter and what counts as a valid knowledge?
- Methodology: What method should the interpreter use to find what is possible to know?

As described by Denzin and Lincoln (1994, p. 109), four major research paradigm types exist: Positivist, Postpositivist (Realism), Critical Theory and Constructivism. Table 2 illustrates the epistemological, ontological and methodological approaches in each of these paradigms.

Table 2: Basic Beliefs (Metaphysics) of Alternative Inquiry Paradigms (Denzin & Lincoln, 1994, p. 109)

Paradigm / Theory	**Ontology**	**Epistemology**	**Methodology**
Positivism	naive realism – "real" reality but apprehendable	dualist / objectivist; findings true	experimental/manipulative; verification of hypotheses, chiefly quantitative methods
Postpositivism	critical realism – "real" reality, but only imperfectly and probabilistically apprehendable	modified dualist/objectivist; critical tradition/community; findings probably true	modified experimental/manipulative; critical multiplism; falsification of hypotheses; may include qualitative methods
Critical Theory	historical realism – virtual reality shaped by social, political, cultural, economic, ethnic and gender values; crystallized over time	transactional/subjectivist; value-mediated findings	dialogic / dialectical
Constructivism	relativism – local and specific constructed realities	transactional / subjectivist; created findings	hermeneutical / dialectical

Positivism views reality as perfectly apprehendable by the researcher. All replicable findings on research are true. The paradigm leans on the quantifiable phenomena and is characterized by hypothesis testing trough quantitative methods. The results can be generalized to whole population. Postpositivism (sometimes referred as "realism") also views reality as apprehendable but only imperfectly due to the cognitive limitations of the interpreter and the extreme complexity of natural phenomena. The reality is never fully comprehensible, but the researcher aims to examine it as closely as possible. With probabilistic approach to findings, replicable research findings are probably true, but can be only partially generalized.

Critical Theory sees the reality as series of cognitive structures molded by culture and environment over time. All findings are accompanied with an assumption that the researcher and the research subject are interactively linked by their predetermined values causing the results of the research to be value-mediated. Both the researcher and research subjects are always individual and no generalizations can be made outside the research situation. Similarly to the Critical Theory, Constructivism emphasizes the subjective perception of an individual on how reality is constructed. The realities created by

individuals are specific and local by nature. The findings are created simultaneously during the research and no generalizations of the findings can be made.

This research is built upon the principles of Postpositivism (realism) paradigm. The role of the researcher is to critically examine as accurately as possible the not-perfectly-comprehensible reality around the research topic.

3.2 Research Design

This section describes the research design of the thesis and provides reasoning for the selected research approach. This study is following a qualitative approach. A Qualitative research is chosen due to the scarcity of existing academic literature of subject and because qualitative approach provides comprehensive insight to the study subject. The aim of this study is to gain deeper understanding of the underlying forces that influence telemedicine adoption, which are not easily quantifiable.

Qualitative research is always an inductive research (Bendassolli, 2013) and therefore it does not aim to test what is already known, but rather aims to expand and develop the existing grounded empirical theories (Flick, 2009, p. 15). Moreover, the objective in this study is not to test the validity of existing adoption models, but rather to explore and put emphasis on new factors that should be considered when using those models to explain telemedicine adoption.

As of today, there exists no paradigm theory on telemedicine systems adoption research and the statistical data of the adoption is scarce. Quantitative research methods are justified when the objective is to test the existing hypotheses and when quantifiable data around the phenomenon is adequate (Park & Park, 2016). For these reasons, qualitative research is more justifiable for this research design.

Qualitative research is defined as a set of interpretive activities which does not necessitate a predefined set of methods (Denzin & Lincoln, 2000, p. 6). Drawing a clear line between data collection and its analysis is not reasonable in qualitative research, as both actions happen at the same time in qualitative research. In this sense, qualitative research always creates a unique relationship between the context, the data and the interpreter. Denzin and Lincoln (2000, p. 6) further note that the researcher should not aim to emancipate him or herself from subjectivity but rather to acknowledge that the character

of the interpreter plays a significant role in the research and analysis. The subjective characteristics of the interpreter should be addressed and taken into consideration when conducting the research.

Qualitative research enables a phenomenon to be studied in all its complexity. Instead of aiming to simplify and generalize the research subject, qualitative research relies on "thick description". This means that the phenomenon is described in high detail, going in depth to characterize it and going beyond what is explicitly visible in the data (Holloway & Wheeler, 2000, p. 7). The thick description emerges from both the context and the data and if done thoroughly, the thick description allows the interpretation to be free from researcher-centric subjective perspective and focus on the phenomena in their local contexts (Yin, 2011, p. 213).

3.2.1 Case Study Research

Case studies are common tools in explorative research. They are often the choice of method when trying to understand complex real-life social phenomena, which requires studying events in relation with their surrounding contexts. (Yin, 2009, p. 4 & p. 18). A defining characteristic of case study research is in the boundaries of the study subject, where the phenomenon and its context cannot be clearly separated (Yin, 2009, p. 18).

The research question, the focus and the contextual properties of the study dictate the choice of a research method. Yin (2009, p. 8) has identified three conditions that facilitate the appropriate choice of the method: The types of research questions posed, the extent of researcher's control over the behavioral events in the study and the time focus. Yin, (2009, p. 8) proposes that a case study is appropriate research method when the research questions are "how?" and "why?" questions. Furthermore, a case study is a useful tool when the researcher does not have control over the relevant behavioral events in the research subject and the research is set on contemporary events. All these notions suggest that case studies are appropriate method for this study.

Historically the quality of case study research has been a subject for an academic debate. The discussion has been surrounding the methodology for its challenges in generalizing the results and the fact, that in certain situations, case studies might inadvertently provide unsuitable scope for the phenomena it is studying (Yin, 2009, p. 14). Even though the validity of case studies as a research method has been questioned, it has

also been attempted to improve by using logical evaluation criteria. Yin (2009, p. 40) suggests exploratory case research to be evaluated throughout the research process with three tests on construct validity, external validity and reliability.

Construct validity refers to the operational measures of the case design, which can be improved by using multiple sources of evidence. External validity refers to the generalization of the results. It measures whether the results of the case study can be generalized beyond the case in question. A method to improve external validity is the replication logic, where multiple case data and findings on earlier telemedicine research are analyzed through the same theoretical framework. These results are consequently cross-compared. Reliability is the level of repeatability of the study. Attempts to replicate the research should arrive at same results as earlier runs of the research. The reliability in this study is improved by following a research protocol which guides the research providing a research path and supporting the creation of thorough documentation of the research steps taken.

A case study design is a logical iterative process which is constantly developing as the analysis proceeds and new knowledge emerges from the study. Figure 8 depicts the logical process of conducting a case study, as presented by Yin (2009, p. 57).

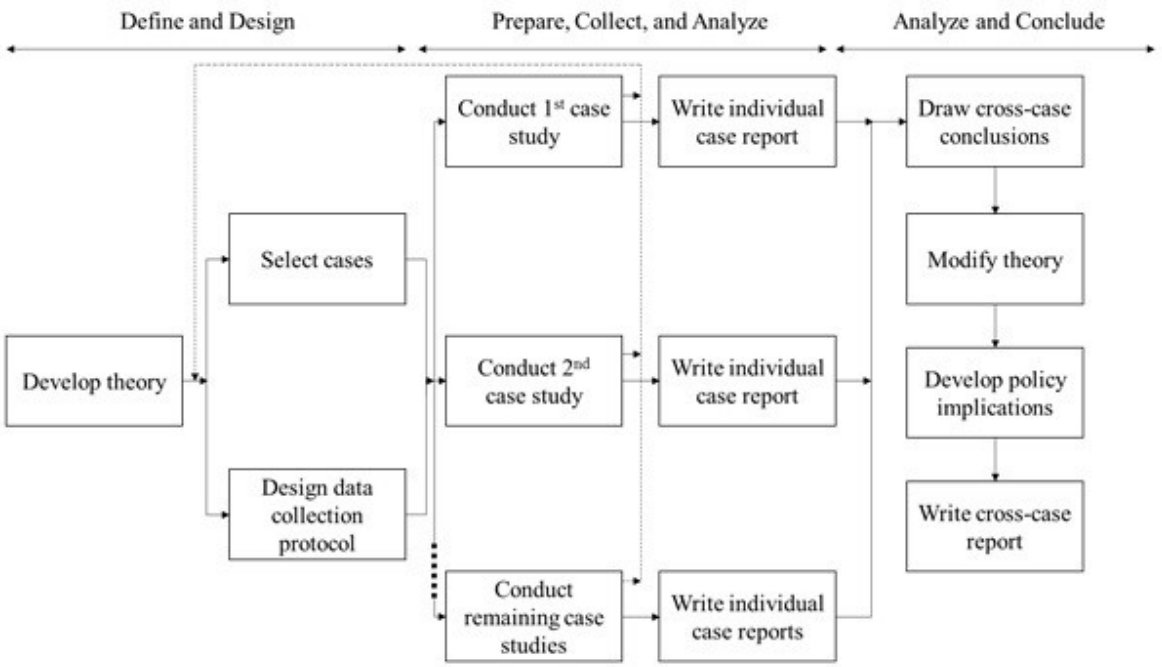

Figure 8. Case Study Method (Yin, 2009, p. 57)

3.2.2 Analysis Design

The empirical part of this study is conducted utilizing thematic analysis of the data gathered with semi-structured interviews. The Constant Comparative Method (sometimes referred as Grounded Theory Method) is being utilized in the data analysis. The method involves data comparison in each stage of data analysis process. The analysis will follow the structure originally presented by Glaser and Strauss (1967, p. 105–113):

(1) Comparing incidents applicable to each category

Coding each incident in the data to as many categories of analysis as possible and comparing them with previous incidents and groups inside the category. Emerging ideas are recorded in memos.

(2) Integrating categories and their properties

When the coding continues, the unit of analysis moves from categorization to comparing the incidents with other incidents and comparing the initial category properties to those that have emerged further in the analysis.

(3) Delimiting the theory

Delimiting is done in two levels: Theory and categories. The theory starts to develop its final shape when no major modifications happen to the categories when new incidents are compared to the category properties.

(4) Writing the theory

In the final phase, the analyst should be familiar with the themes that arose from the data and its analysis.

The purpose of this thesis is not to propose a new formal theory using the Constant Comparative Method, but rather to study and understand the factors affecting the motivation for telemedicine technology adoption. The method applied here follows a rationale of Grounded Theory "lite" (Braun & Clarke, 2008), which does not necessitate full commitment in directing the analysis in the direction of theory development. Instead, the rationale views the Grounded Theory and Constant Comparative Method as rules and toolsets for the analysis.

To alleviate the possible limitations on validity with the relatively small sample size from telemedicine industry, in addition to applying cross-comparison (Constant Comparative Method) of the interview data, the data is compared with earlier findings from telemedicine adoption studies. This process, known as triangulation (Flick, 2009, p. 21), is applied in pursuit to strengthen the validity of the analysis. The findings are subsequently presented in the form of an empirically reviewed research model.

3.3 Data Collection and Characterization

The primary source for empirical data in this thesis is the data gathered through semi-structured interviews which are commonly used tools in case study research. Seidman (2006, pp. 9) stated that the purpose of interviews is not to seek answers to predetermined questions or to test hypotheses, but to understand the lived experiences of the interviewees. The characteristics of the interviewees span from the clinicians who are accustomed to use telemedicine in their work to persons who have managerial insight from the healthcare industry or telemedicine systems development.

The number of interviews was not predetermined prior to beginning of the research. Seidman (2006, p. 55) has presented two criteria for sufficient number of interviews in a qualitative research. Enough interviews cover the topic or phenomenon fairly and reasonably. Secondly, the saturation of information is caused when no new information arises from the interviews. In this research, both prerequisites were satisfied with six semi-structured interviews. Table 3 summarizes the information of the conducted interviews.

Table 3: The Interviewees and Their Areas of Expertise.

Date	Name	Position and Company	Expertise
21.6.2016	Jani Korpela	Chief Executive Officer of Suomen Kotilääkäripalvelu Oy	Economics of healthcare. 6 years of developing telemedicine services.
16.2.2017	Mikko Nyman	Chief Dental Officer at Suomen Kotilääkäripalvelu Oy, General Dentist	Licenciate of Dentistry, telemedicine systems development and use.
17.2.2017	Jarkko Saramäki	Chief Medical Officer at Suomen Kotilääkäripalvelu Oy, General Practitioner	Licenciate of Medicine, telemedicine systems development and use.
10.3.2017	Joni Kokkonen	Business Planner at Helsinki University Central Hospital (HYKS)	Budgeting and financials of healthcare organizations.
31.3.2017	Teddy Grenman	Chief Executive Officer of Edocare Oy	Telemedicine systems development.
19.4.2017	Sebastian Siegfried	Financial Planner at Dictamen Oy	Budgeting and financials of healthcare organizations.

The semi-structured interviews took place between 21.06.2016 and 19.4.2017. All interviewees were contacted beforehand either by phone or email and the interviews were scheduled to an approximately week after the initial contact. The interviews were digitally recorded and the recordings subsequently transcribed for coding and analysis. MS Excel spreadsheets were used to chart the emerging themes.

The data collection in this study is done by methods which emphasize the emerging nature of information through the interviews. Such non-linear method stresses the importance of laying out the ground rules and steps to be taken in the analysis (Seidman, 2006, p. 39). Thorough preparation, planning and following the structure cannot be dismissed despite the loose structure of the interviews. Consequently, all discussions with the interviewees were categorized under four main themes, which were:

1. The Current state of telemedicine technology
2. Motivation for telemedicine use
3. Technology adoption
4. The future of telemedicine

The four categories had 1 to 4 example questions to give initial navigation for the interview discussions. The interviews were subsequently allowed to dwell freely deeper into the topics. The base-structure for the interviews and initial example questions are presented in Appendix A.

3.4 Research Ethics

A researcher must always carry a high level of research integrity and is responsible to undertake all the necessary procedures to ensure that the research is conducted and presented in an accurate and fair way (Yin, 2011, p. 41). This is especially important in qualitative research, as the research boundaries and methods are not strictly defined and leave a lot under the consideration of the researcher (Yin, 2011, p. 41).

All interviews were conducted under the consent of the interviewees. Participation in the study was voluntary for all interviewees. A permission to record, transcribe and use the interview material for the thesis was asked prior to the interviews. The data collected during the interviews was handled with confidentiality and an option of not disclosing any personal information in the final paper was presented for each interviewee.

4 Findings

In this chapter, the research model is used as the base structure to present the findings from the empirical data. Firstly, the factors affecting telemedicine adoption are presented with their relation to the technological context of the adoption decisions. Secondly, the organization-specific factors which emerged from the interview data are introduced. Environmental context factors, such as market structure and the role of legislation are subsequently addressed. Finally, the decision-making structures in healthcare organizations and the factors affecting the telemedicine adoption decision are presented.

4.1 Technological Context Factors

The rate of telemedicine diffusion was agreed by all interviewees to be very slow, but all unanimously stated believing that telemedicine will be an integral part of healthcare in the future. In addition, the interviewees noted that most of the healthcare organization's personnel are familiar with at least some kind of high technology healthcare services, telemedicine technology has not been diffused on a large scale in Finland or globally.

Depending on the occupational background and the area of expertise of the interviewee, slightly different angles to telemedicine adoption emerged during the interviews: Interviewees from business backgrounds suggested that the slow rate of adoption was mainly a financial or resource-related issue, whereas interviewees with clinical background focused on issues related to the usability and usefulness of telemedicine technologies.

4.1.1 Perceived Usefulness of Telemedicine

The interviewees unanimously agreed Perceived Usefulness of telemedicine to play an integral part in the adoption. If the technology is perceived to have no use for the organization or the individual's work, the adoption will not happen. Healthcare organizations have tight budgets and are not acquiring technology if there is no explicit need for it. In addition, Perceived Usefulness includes the evaluation of the feasibility of the new technology in the current infrastructure. Naturally, if the technology is not technically possible to be implemented, its usefulness to the organization is nonexistent.

Interviewees with background from clinical work saw telemedicine technology's potential in increasing the convenience and job-performance of its user. It became obvious

through the interviews that the medical personnel conceive telemedicine technology as instrument for them to perform their job. The potential users of telemedicine evaluate if the instrument in question enables them to perform their job better, which supports the argument posed in the TAM of the importance of instrumental value of the system.

> *"A great example would be a situation where you need to perform a critical operation to the patient, let's say, a car crash site […] In that situation, it would be really convenient to have somebody to see the patient and your hands through video link and giving guidance via earpiece or such." (Interviewee D)*

The assumptions posed in Diffusion of Innovations theory (Rogers, 1983) suggest that the diffusion and the continuity of the use of the technology will advance when the positive benefits of the technology are realized by the potential adopters. This proposition is in line with the findings from the interviews. The initial use of the system alleviates the disparity of innovation evaluation information and the potential benefits of a telemedicine system were seen likely to be realized after the first use. After the experience of the user increases, the adopters are more willing to continue to use the system as the quote from Interviewee A suggests:

> *"People who used it the first time realized that this system is useful and were likely to use it again. The threshold to use the system for the first time is rather big, but when you initially use the teleconsultation system, you will continue to use it." (Interviewee A)*

The quote also demonstrates that the usefulness of the technology is essential in the adoption, but to induce the perception of usefulness, the benefits of the technology must also be demonstrated and communicated. The interviewees were of agreement that demonstrating the usefulness of the technology is a key-part in telemedicine implementation. The identified importance of initial demonstration is in line with findings from the TAM literature (Davis, 1989) suggesting that the users are willing to accept somewhat lower level of Perceived Ease of Use if they feel that the system would otherwise perform an essential part in their work.

4.1.2 Perceived Ease-of-Use of Telemedicine

The interviewees were unanimous about considering the Perceived Ease of Use as a highly influential factor for the telemedicine system to be adopted. Notions in line with the prepositions in the TAM (Davis, 1989; Rho et al., 2014) were also presented, stating that the prospective users tend to avoid using practices that seem to be laborious to learn. This avoidance is depicted in the quote from Interviewee A below:

> *"If the service is even a bit too complicated, no one will ever use it. […] If there's even something a little bit vague to me, who has been developing the service, I'm certain that the person who should use it finds it even more unclear." (Interviewee A)*

The ease of use seemed particularly important in the initial pilot phases of the systems because the users were characterized to be increasingly critical towards any possible shortcomings in the system. Venkatesh et al. (2003) explain this phenomenon with a rationale that increasing user's Past Experiences lessens the need to learn to use the technology again. This consequently makes Perceived Ease of Use less significant factor in explaining the adoption as opposed to the Perceived Usefulness. Regarding the telemedicine systems development and initial use experiences, Interviewee A noted that after the initial introduction of the system, the complexity could be increased after the users have been acquainted with using the system.

The Perceived Ease of Use was not generally seen as a main challenge in the telemedicine system development. Nonetheless, Interviewee E noted that the ease of use does play a part in attracting more users, but the real challenge in the development is finding the right points to improve, as the quote below quite well demonstrates:

> *"[…] All the development efforts should be aimed to increase the number of users by optimizing the system and so on. The real problem is, we do not know what is the 'thing' that should be changed to attract more users. What should be optimized?" (Interviewee E)*

Even though the challenges in telemedicine development are not exclusively related to the ease of use of the system, the interviewees also noted that the systems to be developed should still have a prerequisite of being simple and straightforward to use.

Systems which are exceedingly laborious to learn would restrict their demonstrability and possibly slow down the adoption.

> *"It [telemedicine application] has to be very simple, because people's ability to use IT-devices might be, after all, astonishingly limited […]" (Interviewee B)*

4.1.3 Perceived Attributes of Telemedicine

Relative advantage

The interviewees agreed that the relative advantage of telemedicine technologies is mainly related to the potential cost-savings and service-improvements. Moreover, in several instances the potential of increasing the quality of care was identified as one possible advantage of telemedicine services. Generally, the interviews suggested that the adopters have multiple goals with which they reflect the relative advantage of an innovation. Following the findings from Perceived Usefulness, clinicians evaluate the relative advantage of the technology by its capability to improve their job performance.

Based on the interview discussions, it is evident that the evaluation of the relative advantage of telemedicine technologies differ between public and private healthcare organizations. In public sector the advantage is related to the possibility to either acquire specific specialized services with ease, lowering the work-load of the physicians or to use technological solutions in triages and queue management.

In private sector, the relative advantage of telemedicine is either seen in increasing the accessibility to the service with digital platforms or with lowering the fixed property costs as digitally produced healthcare services do not require as substantial investments in appointment rooms and buildings. A few interviewees noted that the motive behind both advantages is that privately-owned companies seek to either increase the volume of their sales or their profit margins.

On a technical perspective, an interesting note about the advantage of telemedicine equipment over traditional medical equipment came up in several interviews. With scarce monetary resources, the developing world will probably take a leap in telemedicine healthcare in relatively faster pace than the developed world. Again, the costs and improvements of the healthcare services is well demonstrated by the following quote:

> *"Mobile technology is something that we can use as vehicle to deliver the diagnostics where people physically are. It is definitely cheaper to deliver the technology to the people and treat them there than to transport those people to centers where the technology is." (Interviewee D)*

Compatibility

The interviews clearly revealed that the technical compatibility of a technology is not the only area where the innovation should be evaluated. Generally, the interviewees agreed that the compatibility of an innovation such as telemedicine is related to the organization's established values, practices and technologies, similarly as Rogers (1983, p. 223) posed.

Several interviewees noted that especially in the established older healthcare facilities, the organization has gone through years of development, optimization and streamlining of its services. Interviewee C discussed about fitting the new technologies with old practices in the healthcare units and mentioned that the organizations might have put enormous time and effort in building the system that is currently in place and are not too keen to change it. Roger's (1983, p. 224) characterized this form of innovation compatibility as Compatibility with Previously Introduced Ideas. Following quote summarizes this thought well:

> *"One unit said, they have already improved and optimized their treatment processes so much that the so called "easy patients" do not come to the specialized unit. They stay at the general healthcare and only the patients who are in need for the specialized treatment are sent to them." (Interviewee C)*

Organizations might identify a problem to be solved in their processes, but do not comprehend telemedicine as a solution to it. This notion rose in several interviews and suggested, that telemedicine might be contradicting with the potential adopter's Compatibility with Needs (Rogers, 1983, p. 225). If the compatibility with needs is low, the potential adopters reject telemedicine technology and pursue in conventional solutions for to the problem at hand as the quote from Interviewee D illustrates:

> *"...they thought that they would ease the problematic too long waiting times of patients by simply adding more labor force. Well, the time I left there, all the open positions were filled, but the problems with queues and waiting times were still there." (Interviewee D)*

Interviewee E noted that organizations might want to acquire technological solutions to issues occurring in the existing processes, but lacking the motivation or skills to restructure their existing services.

> *"A friend of mine, who is a Physician, put it nicely: 'I think it's childish to merely book more phone appointments and then call it telemedicine'." (Interviewee E)*

Complexity

Multiple interviewees characterized telemedicine as highly complex technology which requires substantial efforts to be properly implemented. The original assumption in the Diffusion of Innovations theory suggests that higher complexity contributes negatively to the adoption of the innovation. The relationship between the complexity to the adoption decisions became clear in the interviews. As an example, Interviewee A described integrating a telemedicine system with an existing patient record system as:

> *"[...] excruciatingly laborious and expensive task" (Interviewee A).*

From the organizational perspective, the high complexity of telemedicine systems influences the adoption decisions, as the deployment of the system might be a complicated and resource-intensive process. On an individual level, the complexity is related to the Perceived Ease of Use of the system and was identified as one factor hindering the adoption by the interviewees.

Trialability

All interviewees were unanimous about telemedicine's distinct requirements as compared to regular consumer technologies. The validation processes of medical technologies demand much more vigorous testing and evaluation than technologies developed to do seemingly similar tasks at the commercial sector. Interviewee D pointed out the importance of operational reliability with medical care technologies. The quote below

emphasizes the incentive to expect trialability from telemedicine technologies, as trialing of the technology would lessen the risks of failure.

> *"Obviously, the technology must be very reliable and specifically approved for medical use and it has to be tested a lot more than regular technologies. […] Also there's a really high responsibility of the technology manufacturer because at the end of the day you are responsible of people's lives – or deaths if the technology is faulty." (Interviewee D)*

Several interviewees noted that being able to do smaller scale test-runs is not an issue with most of the common telemedicine technologies. In most cases, the technologies and telemedicine applications were suitable for trial-runs.

> *"[…] any kind of technical solution, product or service, if it works every single time it is used, it will be continued to use and it will be used more, but I don't think that is the problem with telemedicine." (Interviewee E)*

Observability

Following the findings from the Perceived Usefulness of Telemedicine, the interviewees were unanimous about the influence of observability to the adoption process. Potential adopters cannot make an informed decision of an innovation if its features are not demonstrated.

> *"To get them use the service first time, it [the benefit] needs to be very clear." (Interviewee A)*

Interviewee F emphasized the importance of user references in demonstrating the features of telemedicine. Among the healthcare organizations, it is customary to arrange expeditions to other healthcare institutions to see how other units work in operation. This is in line with propositions posed by Liu (2011), who suggested staff participation in seminars and expeditions to be an effective way to increase the organizational knowledge of telemedicine technology.

4.2 Organizational Context Factors

To address the dynamics of the organizational adoption, the interviews contained topics related to the organizational readiness to adopt telemedicine technologies. A clear consensus among the interviewees was found that the existence of knowledge barriers is indeed present in the healthcare organizations.

4.2.1 Technical Knowledge Barrier

The interviews clearly pointed out that implementing a telemedicine system into organizational routines is a learning process. All interviewees stressed the importance of organizational learning and noted that technology implementation demands proper managerial and organizational structures in place, enabling the new knowledge of the innovation to be learned.

> *"There is a massive task of educating the customer in using those technologies. We have, what? 200 – Hundreds of years done things in a certain way: The patient visiting a doctor or vice versa. Suddenly everything should be turned upside down." (Interviewee E)*

Following the views of Grigsby et al. (2002), a few interviewees identified a need to treat telemedicine technologies as radical innovations. Interviewee B pointed out that directly transforming conventional healthcare services to digital format will not work, as digital services are offered in a completely different environment:

> *"[...] we formerly thought that we can just continue providing the conventional medical services but just do everything digitally. That's not how it goes at all." (Interviewee B)*

More than the attributes of the technology itself, the interviewees stated that the organization's openness to innovations plays a large role in the adoption. The consensus among the interviewees was that when developing telemedicine services, the whole service model of the organization must be restructured from the bottom. The following quote demonstrate these notions effectively:

> *"In order to start developing the more radical type of service like remote appointments, the change has to be made at a much earlier stage in the service development. Basically, they have to start from the scratch." (Interviewee C)*

Nevertheless, the examples which arose during the interviews implied that telemedicine innovations are not nearly always considered as radical innovations, but simply incremental additions to existing services:

> *"It just doesn't go like that. – That physical appointments with patients are moved to digital services. What happens is that this service to be implemented is just 100% addition to the existing services for the patients, not a new service." (Interviewee C)*

4.2.2 Economic Knowledge Barrier

The interviewees were of agreement that there exist no generalized business models for telemedicine. This is in line with the views of Tanriverdi and Iacono (1999), who argued that telemedicine's main economic barrier is the absence of working business models and best practices. This became evident from the interviews, as the quote from Interviewee B illustrates:

> *"There has to be plenty of users and use-experiences and through that a correct model is found, because nobody, according to my knowledge, at this moment knows what is the most usable thing." (Interviewee B)*

The interviewees were unanimous in their reasoning that telemedicine technologies must satisfy requirements of a multitude of interest groups before the adoption is considered. The most commonly mentioned telemedicine stakeholders were Chiefs of Medicine and Dentistry, municipal council health board members, board members of the organization, IT-management and national health agencies. The Chief of Medicine is usually responsible of the acquisitions and investments in the healthcare unit. However, often the final decision is made collectively at a higher administrational level. In public sector, this usually means the municipal health council, which allocates funding for the healthcare units.

> *"...it doesn't matter how medically skilled and intelligent these people are, they still need to convince the actual municipal council to give funding to them. This is where the projects are usually stopped." (Interviewee D)*

In private sector, the decision-makers are typically the board members and owners of the organization. Private organizations might have an incentive to implement telemedicine services when they provide cost-savings or advantage over the competitors. However, telemedicine implementation is expensive and costly process. Without proper business models and implementation practices its outcomes are uncertain. Several interviewees noted that the private companies lack the interest to develop their own telemedicine models and would instead buy ready solutions. These notions are well expressed in the quote from Interviewee B:

> *"They do not even time to think anything like this, because it is such a slow process. So, that fails because of that. They do not, by any means, have interest to seek savings for the municipalities, or to the society. The private equity owners sole purpose is to make profit. They can seek savings by implementing a working telemedicine model in some of their processes, but that requires that that model should work." (Interviewee B)*

Multiple interviewees identified a conflict between the earning logic of private healthcare companies and telemedicine services. Private healthcare organizations often earn most of their income by the volume of patient visits. Therefore, if telemedicine would potentially lessen the need for in-house visits, the current earning logic in place would not work anymore. Following two quotes demonstrate this conflict well:

> *"Someone is currently operating there and earning his or her salary by doing the work by billing the patients – they don't want to interrupt or risk that. They are just content on how things are. A prime example would be occupational healthcare, which is mostly very basic healthcare. That could be completely diminished with telemedicine, but why would they want that?" (Interviewee E)*

> *"...and it is a matter of earning logic too. The private sector earns money by selling products and their 'products' are the swings of the door. Lab test, imaging and so on. It would be horrible business for the private sector companies, if the patients would start to treat themselves" (Interviewee D)*

4.2.3 Organizational Knowledge Barrier

The importance of managerial practices in telemedicine adoption became evident in all interviews. The organization's formal and informal structures were mentioned to contribute to the ability to successfully adopt telemedicine technology. Managers play a key part in forming these structures as they are in position to allocate sufficient resources for the deployment of new technologies.

> *"The change would most likely come from the clinic manager. Change the working hours and change the organizational culture." (Interviewee A)*

The managerial practices were not only seen as enabling factors in telemedicine implementation. Contradictive attitudes from the management might also have a negative effect on the adoption, as the following quotes point out:

> *"The Chief of Medicine was so conservative. He felt that everything should be done exactly like it has been done earlier. In his opinion, the patient-doctor interaction is 'sacred' and should not be interfered with new technology." (Interviewee D)*
>
> *"I argue that at that moment when it comes a daily routine for the hospital management to have, for example, video meetings daily among the administration level, only then there exists a route for telemedicine services and through that the service is either brought in or created in the organization." (Interviewee B)*

The interviewees were unanimous about the importance of appropriate resource allocation inside the organizations. This notion was also evident in the literature review, where. The allocation of resources, such as time, support systems and proper learning tools was agreed to be a major impacting factor in telemedicine adoption.

> *"[...] from the very foundation of the organization, you must allocate weekly time for the staff to consult, study or do whatever related to the teleconsultation. After the organizational practices are in place and established, [...] it is impossible to bring this kind of system in anymore." (Interviewee A)*

The consensus among the interviewees was that telemedicine implementation is a time-consuming process, but often the working schedules of clinicians are so tight that there is no time to learn to use a new system. If clinicians must learn to use a new

telemedicine system while maintaining their normal working routine, the adoption is less likely to happen.

> *"It [Allocating time to learn to use telemedicine] is something which is virtually impossible to achieve in Finland… Or you must have an enthusiastic change leader in the management. Someone who understands what it takes." (Interviewee A)*

4.2.4 Social Influence

Interviewees with antecedents from clinical work mentioned that past experiences and attitudes towards previous telemedicine technologies influence the adoption decision. Bad experiences of telemedicine systems appear to have a negative effect on the probability to adopt telemedicine technology.

> *"If I would be put in a place where I would be in a serious critical situation with a patient and need to use some technological device – if that device fails to function as it should, one way or another; I would never touch that device again." (Interviewee D)*

Interviewee D emphasized the role of perceived psychological risk of the clinicians who could potentially use telemedicine technology. In this case, psychological risk is related to the clinician's self-perception as professionals who might put their reputation at risk if they choose to use telemedicine technology. A quote from Interviewee D clearly demonstrates that the trust in telemedicine technologies plays a big part in the adoption decision making:

> *"That authority of a medical personnel is a delicate matter and if there is something that could possibly break the impression of the authority between the patient and the healthcare professional, say, a faulty mobile application or such, I think the medical personnel would be less likely to use that technology in the treatment situations. They don't want to jeopardize their authority or professionalism." (Interviewee D)*

On the other hand, social influence might affect the adoption decision positively, if the clinicians are convinced that using telemedicine does not pose a risk to their reputation. The importance of references in telemedicine adoption was mentioned by a few interviewees

> *"There is definitely word-of-mouth effect with telemedicine technologies. […] Finland is such a small country. So, at least in the management level of municipal sector, everyone knows everyone. Acquiring good references here does mean a lot for your business." (Interviewee F)*

4.3 Environmental Context Factors

4.3.1 Industry Characteristics

The interviews suggest that in many instances, the telemedicine diffusion systems are leaning towards centralized diffusion systems. Following the views of Rogers (1983) and Greenhalg et al. (2004), the centralized diffusion systems employ lower level of innovativeness than decentralized systems. Indications of the centralized diffusion system are demonstrated well with the following quote:

> *"Their [Physician's] opinion doesn't matter at all. It is all in the hands of the Municipal Council and the Health Director there, because everything costs money." (Interviewee D)*

The interviewees did not acknowledge a link between the healthcare market structure and the rate of diffusion of telemedicine in Finland. Moreover, the division between the incentives of public and private healthcare organizations was not considered as a significant factor in telemedicine adoption. For the adoption, a larger issue was brought up on the lack of motivation to change the current operating models in healthcare:

> *"The biggest problem for telemedicine now is probably that the current situation is Finland is more of less good in healthcare sector. In many places the healthcare works fine or at its worst, it's still adequate. There is no urgent need to change that." (Interviewee E)*

4.3.2 Government Role

The interviews revealed that the government plays at least two important roles in the telemedicine technology diffusion. Firstly, the national administration is responsible for regulating the healthcare practices through the governmental agencies. Secondly, the national legislation sets the minimum requirements for the health services provided but

also poses limitations to what extent the healthcare services can be delivered through digital mediums.

> *"[...] in Finland it [the legislation] is a major restriction. [...] in the mid-January 2016, they made an initial change in the law, that people are even allowed to develop these medical services. [...] now at least they don't ban people from developing them." (Interviewee B)*

Nevertheless, a few interviewees pointed out that Finland does not have a highly restrictive regulation over telemedicine as compared to some other parts of the world. It was noted that the government also deploys initiatives that support the use of telemedicine technologies, such as national electronic patient record system or the national electronic prescription scheme. As the following quote from Interviewee A suggests, the government can actively participate in encouraging the use of telemedicine:

> *"One route would be to think about changing the culture through government officials. For example, with, VALVIRA, The Dentist Union or The Medical Doctor Union, we could think how to make rules that would promote the formation of a consultation culture.", (Interviewee A)*

The tethering legislation in Finland was raised as a concern by Interviewee E. The national tethering policies are highly obstructive in allowing telemedicine applications to be included in the tethering processes. Often, the tethering processes are made solely for either medical personnel or equipment, as the quote from Interviewee E points out:

> *"It would be different thing to tether medical services, both telemedicine and physical doctors, then telemedicine would be offered and bought. Now the starting point is almost always in physical doctors and telemedicine is helplessly looked over by that. Only in private sector they hire telemedicine developers and such but those are rare occasions as well." (Interviewee E)*

4.3.3 Technology Infrastructure

The current state of technology infrastructure in Finland was generally seen sufficient for telemedicine technology implementation. It was also noted in several occasions, that the nature of the services dictates the need for the infrastructure to be in place. Naturally, the

infrastructure sets limitations to telemedicine technologies and if substantial changes in technological infrastructure are needed, the adoption is less likely to happen.

> *"That sort of service could be arranged but that would require enormous amounts of additional infrastructure to be in place as well. The whole structure should be changed in order it to work. And if you start changing the whole structure, the risks are high." (Interviewee E)*

4.3.4 Culture

During the interviews, it became evident that the healthcare industry is surrounded by culture which leans heavily on scientifically proven evidence. The interviewees with antecedents from clinical work pointed out that healthcare professionals often share a culture of traditionalism in their field of expertise. Most of the interviewees noted that this sort of traditionalism is especially manifested with healthcare personnel of older age. The new generation of both clinicians and patients were seen to be more open to new technological innovations in healthcare.

> *"There was, first of all, a discussion about the certain type of protectionism among doctors, but on the other hand, when the generation changes, all of our previous understanding will be replaced." (Interviewee D)*
>
> *"I feel that they fear for their jobs. That somehow the new technology would supersede the human doctors." (Interviewee F)*

Interviewee A noted that in healthcare, the professional culture is valuing the knowledge of individuals and it is possible that the knowledge-centered culture prevents the individuals to establish themselves in professional communication. A good example of this trait can be demonstrated from the discussions with Interviewee A. When asked about the biggest barrier in implementing a doctor-to-doctor teleconsultation system in healthcare organizations, Interviewee A stated:

> *"The biggest barrier here in Finland is the high threshold to consult someone […] most of the times Physicians and Dentists are so proud that they do not consult anyone. Many of them deem to know everything, so there's no need." (Interviewee A)*

Apart from the healthcare professional field, cultural barriers to telemedicine adoption were identified also in the patient sector. When discussed about the consumer applications of telemedicine technologies, such as patient-to-doctor mobile applications, the question of information privacy came up in several instances.

> *"Telemedicine can actually be a really intrusive technology in terms of personal privacy." (Interviewee D)*

In contemporary times, personal information privacy is under a heated discussion and the privacy was identified as the most common reason for IT-abandonment by Hart et al. (2010). Medical information is particularly sensitive form of data, which is likely to raise concerns about its confidentiality when using digital platforms.

4.4 Decision-Making Factors

Several interviewees stated the lack of influence over decision-making to be a potential source for slow rate of technology diffusion. A single clinician does not have much influence over the decisions of telemedicine adoption and is not usually included in the decision-making processes of the organization. It was also argued that many of the clinicians do not want to participate in the decision-making because they feel that the decisions are out of their control or expertise.

> *"Who we contact in the organization depends a lot. We have the service side and the technological side and those functions are sold to different entities in the organization. They are the ones who evaluate whether the product is needed and their responsibility is to make internal marketing inside the organization." (Interviewee F)*
>
> *"Usually, if you were to vote on something like that [telemedicine implementation] among the public-sector Physicians, two of 10 participants would vote 'yes" and zero 'against'. Eight of them would just stare at the floor and vote: 'whatever'." (Interviewee D)*

Contrary to what the Diffusion of Innovation theory suggests, the interviews revealed that the optionality to use telemedicine technology was not clearly identified as factor affecting the adoption. Moreover, the interviewees provided examples of instances

where authoritative decision to adopt telemedicine was made with considerably successful results. The Finnish municipalities are required by law to maintain a certain service level in their healthcare plan. For example, the citizens of the regions must have access to certain Specialist services. Interviewee B pointed out that even if there is no motivation to voluntary adopt telemedicine services, when there is an absolute must, the services can be successfully taken into use.

> *"[...] you had to have so atrocious need or a problem. For example, in a certain remote Finnish region, they faced penalty charges and had VALVIRA breathing down their necks. Then they had to take telemedicine services into use." (Interviewee B)*

5 Discussion and Conclusions

In this chapter, the essential findings from the empirical data analysis are summarized from the previous chapter. The research model used in the analysis is consequently reviewed through the findings and answers to the research question are addressed. In the final section, the theoretical and managerial implications are discussed and presented.

5.1 Summary of Findings

The objective of this study was to shed light to the underlying factors affecting telemedicine technology adoption both in individual and organizational level. The factors were sought through four different contexts: Technological context, organizational context, environmental context and the innovation-decision context. Factors influencing the individual level adoption as well as organizational adoption were found from all four contexts. In principle, the findings present a sample of healthcare-specific factors which influence the decisions to adopt or reject telemedicine technology.

In technological context, the most significant attributes of the technology were related to the communicability of telemedicine's features. The findings suggest that trialability, observability and complexity contribute to the adoption decisions by dictating how easily the features of telemedicine can be communicated to the potential adopters. Essentially, the demonstrability of the technology's benefits was found to be the most influential factor for the adoption decisions. The demonstrated features of the technology consequently lead the potential adopters to evaluate the system's relative advantage over conventional healthcare practices. Therefore, in addition to the communicable benefits of telemedicine, the relative advantage was found out to be influential for the adoption decisions as well. These findings conform with the assumptions posed about innovation attributes in the Diffusion of Innovations theory (Rogers, 1983).

The perceived usefulness was found out to be an important factor influencing telemedicine adoption both on individual and organizational levels. The usefulness was identified to have at least three purposes of enhancing the user's work-performance, increasing the quality of the services or increasing the accessibility of the services. Perceived ease of use proved to be an influential factor to adoption decisions in the initial demonstrations of telemedicine's features, but was not considered as significant after the

potential adopters were familiar with the technology. This notion was also addressed in the original assumptions posed in the TAM (Davis, 1989) and confirmed later in the telemedicine adoption literature (Rho et al. 2014). After the features of the technology are comprehended by the potential adopters, the findings imply that the potential adopters evaluate the compatibility with current needs of the organization. If the technology seen suitable for the situational needs of the organization, the adoption is more likely to occur.

In the organizational context, the findings imply, that the adoption decision is influenced by the formal and informal structures of the organization, as suggested by Baker (2012). The findings suggest that successful telemedicine adoption requires changes in these structures and the adoption decision is dependent on the organizations openness to change. Furthermore, telemedicine adoption is highly resource-consuming which requires sufficient resources to be available and allocated in building telemedicine support structures and processes. Finally, the findings imply that the adoption decisions are evidently influenced by the managerial efforts in promoting an organizational culture that encourages the use and learning of telemedicine. These notions are in line with the conclusions presented by Tanriverdi and Iacono (1999) in the Knowledge Barrier Approach.

Environmental factors affecting telemedicine adoption were most noticeably related to the professional culture surrounding the healthcare industry and to the role of the authoritative agents. Government institutions and their efforts to promote or restrict technology use in healthcare were found to have some impact on the adoption decisions. The legislation in Finland was not generally seen as a barrier for telemedicine diffusion, but government initiatives to support the adoption of telemedicine technologies were identified as a potential source for aiding the adoption. Lastly, the findings suggest cultural attitudes towards information privacy to be a factor influencing the individual adoption decisions. This finding is in line with the views of Mansouri-Rad et al. (2013) who suggested that the concerns about information privacy present barriers to telemedicine adoption through the external culture.

There was no clear consensus among the interviewees about the factors influencing the innovation decision making. The Diffusion of Innovations theory (Rogers, 1983) suggests that optionality contributes positively to the adoption. However, the interviewees mainly mentioned instances where the adoption successfully happened by authority

decisions. Moreover, the interviewees generally characterized the decision-making structures to be authority-dominant in the healthcare organizations, as it was evident that the users of the technology do not ultimately have control over the adoption decisions.

To summarize the key findings across the four contexts, the demonstrability of the technology's benefits rose from both technological and organizational contexts and discussion of its positive influence on adoption was found in all interviews. Furthermore, appropriate organizational structures and ineffective allocation of resources were the most commonly mentioned reasons to stall the telemedicine diffusion.

5.2 Empirically Reviewed Framework

Through the analysis it became evident that substantial factors were left out from the original research model due to the limited scale of this study. However, evidence of most of the factors identified from the literature review was found through the empirical data analysis and the relative dynamics between the factors could be accordingly analyzed. Essentially, the analysis revealed that the relative strengths of the factors were gravitated towards the importance of the demonstrable potential benefits of telemedicine technology and organizational structures in healthcare organizations. Figure 9 depicts the updated research model incorporating the empirical findings of the study.

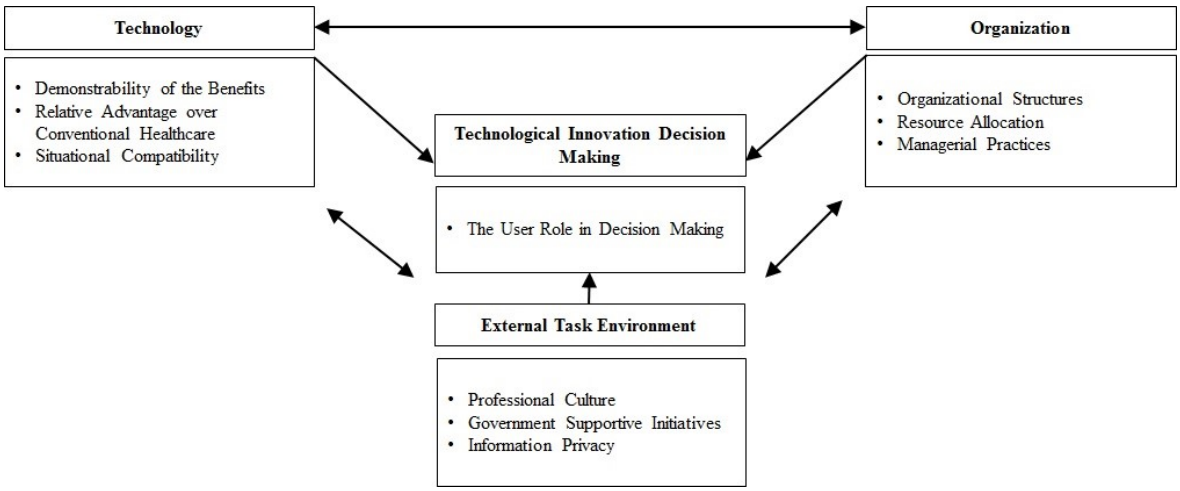

Figure 9. Empirically Reviewed Research Model of Factors Influencing Telemedicine Diffusion

5.3 Discussion

The research questions in this thesis were set to discover the main factors that influence telemedicine adoption and investigate how these factors should be taken in consideration when developing, deploying and using telemedicine technologies. The key finding implies that the need for telemedicine technologies is not obvious for the potential adopters. Even though the demonstrability of telemedicine's features was noted as a major force influencing the adoption, it can be argued that ultimately the whole adoption is dependent on the adopter's need for such technology.

Through performing this research, it became apparent that when attempting to study telemedicine technologies as whole, the analysis is bound to happen on a very abstract level. Telemedicine technologies differ from each other and it is challenging to distinguish whether some discovered trait is related to the technology or to the concept of telemedicine itself. It is also evident, that all the studied cases in this study view telemedicine through their own cognitive processes hence it is up to the organization's or individuals own perception whether the telemedicine technology has value to them. It can be argued whether telemedicine has substantially differing traits from any high-technology innovations but it is evident that the healthcare industry displays differences with consumer industries. The culture in healthcare industry is valuing the importance of scientific evidence in all its functions which might not be the case with consumer technologies.

On a methodological perspective, the proposed research model entails many elements which in practice are overlapping. Therefore, the division of the model to different contextual elements proved to be unsuitable structure to analyze how different factors moderate each other. A more suitable method for this would be to perform the analysis independent from predefined categorization. Nevertheless, for the objectives of this thesis, the categorized analysis of the factors can be justified. A major methodological issue which was already expected prior to the analysis, was that when conducting a multiple case analysis, comparing the different cases together provided only abstract results. More concrete results could be achieved by either choosing the cases which are as similar to each other as possible, or simply including a smaller number of cases to be studied at once.

Telemedicine is already utilized in healthcare organizations, even though the larger scale diffusion is probably yet to come. The technology offers exciting possibilities for the future of healthcare, but it was also interesting to find hints about possible ethical disadvantages of telemedicine services. Healthcare entails practices where the sense of caring and human factors are of high importance. Bringing technology along to this equation seemed to raise some negative connotations, as was evident from some experiences of the interviewees.

Another curious notion rose from the interviews as all interviewees were certain, that telemedicine will be an enormous business in the future. The new generations of medical professionals as well as their patients are becoming more and more accustomed to use high technology products in their daily life and it seems inevitable that healthcare services are going to be delivered via digital mediums at an increasing rate in the future. Digitalization of the healthcare services is a part of larger socio-economic shift which is not only affected by the healthcare development, but by how information technology is changing our consumption behavior of services. Indeed, the changes in consumer behavior will probably be an important driving force also for the digitalization of healthcare services.

5.4 Theoretical Implications

This study contributes to the technology adoption theories by contextualizing the adoption models with characteristics from telemedicine adoption. The findings from the analysis of the empirical data are mainly in line with the propositions posed in the extant telemedicine adoption literature. Reflecting the findings through the theoretical framework posed in the research model suggests that to gain more comprehensive view of the telemedicine diffusion, the factors affecting the adoption decisions should be studied in multitude across various adoption models.

Additionally, the findings suggest that separate adoption models might leave important aspects of telemedicine diffusion structures out, if treated as standalone models. The narrow scope for example in the TAM does not acknowledge the existence of organizational structures which might substantially affect the adoption decisions and how the individuals perceive the system's usefulness. On the other hand, the strength of particularly narrow scope of interest allows the models to be used to gain accurate insight from a chosen angle to the phenomenon in question.

5.5 Managerial Implications

The analysis of the findings and prior academic literature revealed interesting managerial implications which might prove to be beneficial in telemedicine technology implementation. As the research question in this study poses, the implications of the motivational factors to adopt telemedicine technology can have a substantial impact on telemedicine development, deployment and use.

The implications of the findings for the development of telemedicine technologies are related to the communication of the potential benefits of the technology. The findings further suggest that the demonstration and trials of telemedicine are essential to persuade the potential users to adopt the technology. Therefore, the developers should consider, whether the technology in question can be tried out with small commitment from the potential adopters lessening the risk they need to take. The demonstrability also suggests a need to develop technologies which are easy to comprehend by the potential adopters.

The deployment of telemedicine technology is inherently influenced by the organizational culture and the structures. The importance of managerial decision in encouraging the culture of learning and purposeful allocation of organizational resources towards the encouragement of telemedicine use are vital. The users of telemedicine should be prepared with enough time from their regular working routine to use telemedicine technologies. Additionally, the supportive structures for technical and medical learning should be made easily available for the users.

To enable the continuous use of telemedicine is a matter of building or restructuring the services of the organization in a manner that telemedicine is essential part of the service delivery. It could also prove beneficial for the organization to build incentives to telemedicine use and structure their employee compensation models in a way that they encourage the continuous use of the technology.

Lastly, the role of governmental authorities should not be overlooked. The government could encourage the use of telemedicine through various incentives posed to healthcare organizations. Examples of these would be to promote the inclusion of telemedicine in tethering processes of the municipalities, increasing the compensation of using telemedicine in governmental healthcare programs or posing supportive legislation for telemedicine initiatives in municipal tethering processes.

6 Study Limitations and Propositions for Future Research

The limited scale of the study imposes it to limitations which are addressed in this chapter. The aim of this research is to shed light on the underlying factors of telemedicine technology adoption, but the empirical scope is limited to Finnish healthcare sector. More fundamentally, the limitations of this study stems from the research paradigm of postpositivism which recognizes the reality to be only partially apprehendable by the researcher. Following this view, the generalizations from the results are difficult to be made as they are results of the researcher's subjective cognitive process.

The empirical data of this study is rather limited and can hardly be considered to represent a significant sample of telemedicine stakeholders. Future studies should incorporate a larger, but more focused sample of empirical data to yield more generalizable results. Further on, it could prove to be beneficial to validate the identified factors, their relative strengths and their explanatory power over the adoption through quantitative methods. Inarguably, important factors to telemedicine adoption were left out of this study due to its limited scale. It would be interesting to consider for example ethical aspects of technology use in healthcare and its effect on telemedicine technology adoption.

During the year 2017, Finnish government has initiated a social and healthcare reformation, which will most likely shape the existing motivational factors and possibly reveal more interesting factors influencing the telemedicine technology adoption in the near future. What is evident, is that at least the business logic of healthcare organizations, both in public and private sectors in Finland, will be changed drastically and this could prove interesting new implications to the motivations to develop or adopt telemedicine services.

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Appendix A: Interview Questions (Translated from Finnish)

Telemedicine Technology Use and Adoption – Interview Themes and Example Questions

Name and title:_____

Place: _____

Date and time: _____

0. Background

1. Current state of telemedicine technology

1.1. Describe your relationship with telemedicine technology?

1.2. How do you utilize telemedicine technology in your work?

1.3. How common is the use of telemedicine is in health care in your opinion?

2. Motivation for telemedicine use

2.1. Do you feel it is important to utilize telemedicine in health care development?

2.2. Who gain benefit from the use of telemedicine and how?

2.3. What possible downsides or shortfalls telemedicine has?

3. Technology adoption

3.1. What factors influence telemedicine technology adoption and development?

3.2. What could enhance telemedicine technology adoption?

3.3. How much is the adoption influenced by:

Perceived utility, economic issues, legislation, ease of use or preconceptions towards new technology?

4. The future of telemedicine

4.1. What parts in telemedicine are the most crucial to be developed in your opinion?

4.2. Do you feel that telemedicine technology will change the health care in the future and how?

4.3. What is the greatest barrier for telemedicine to become more common in health care?